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Cyclist

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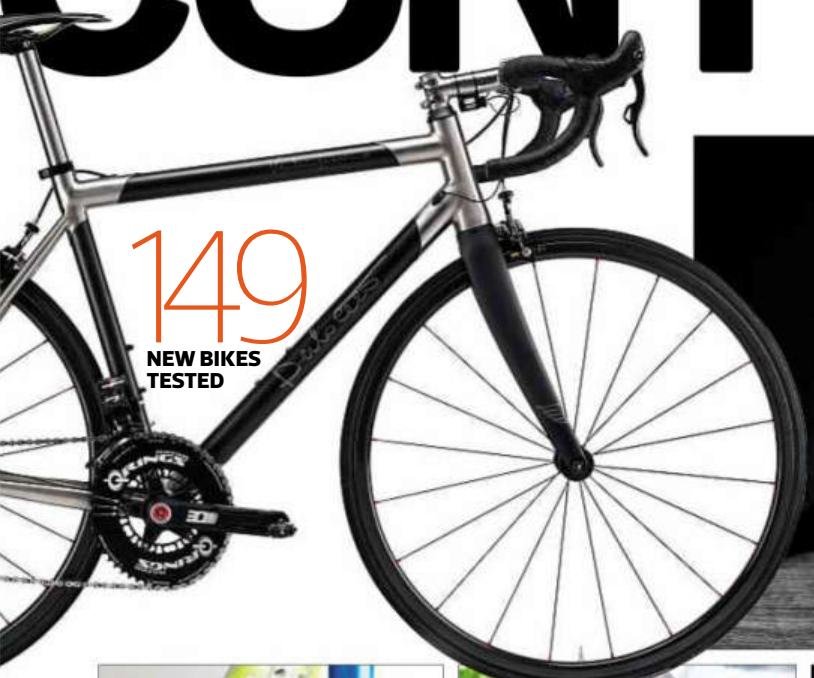
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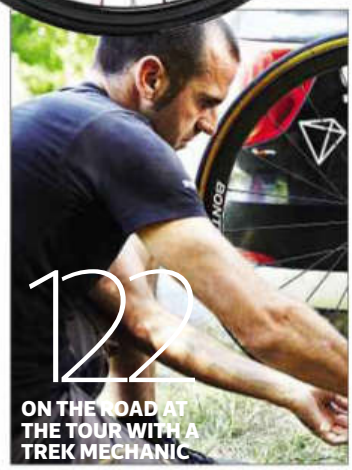
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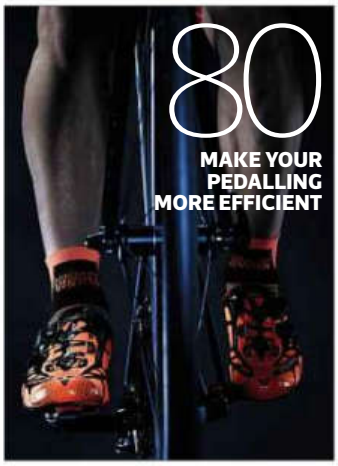
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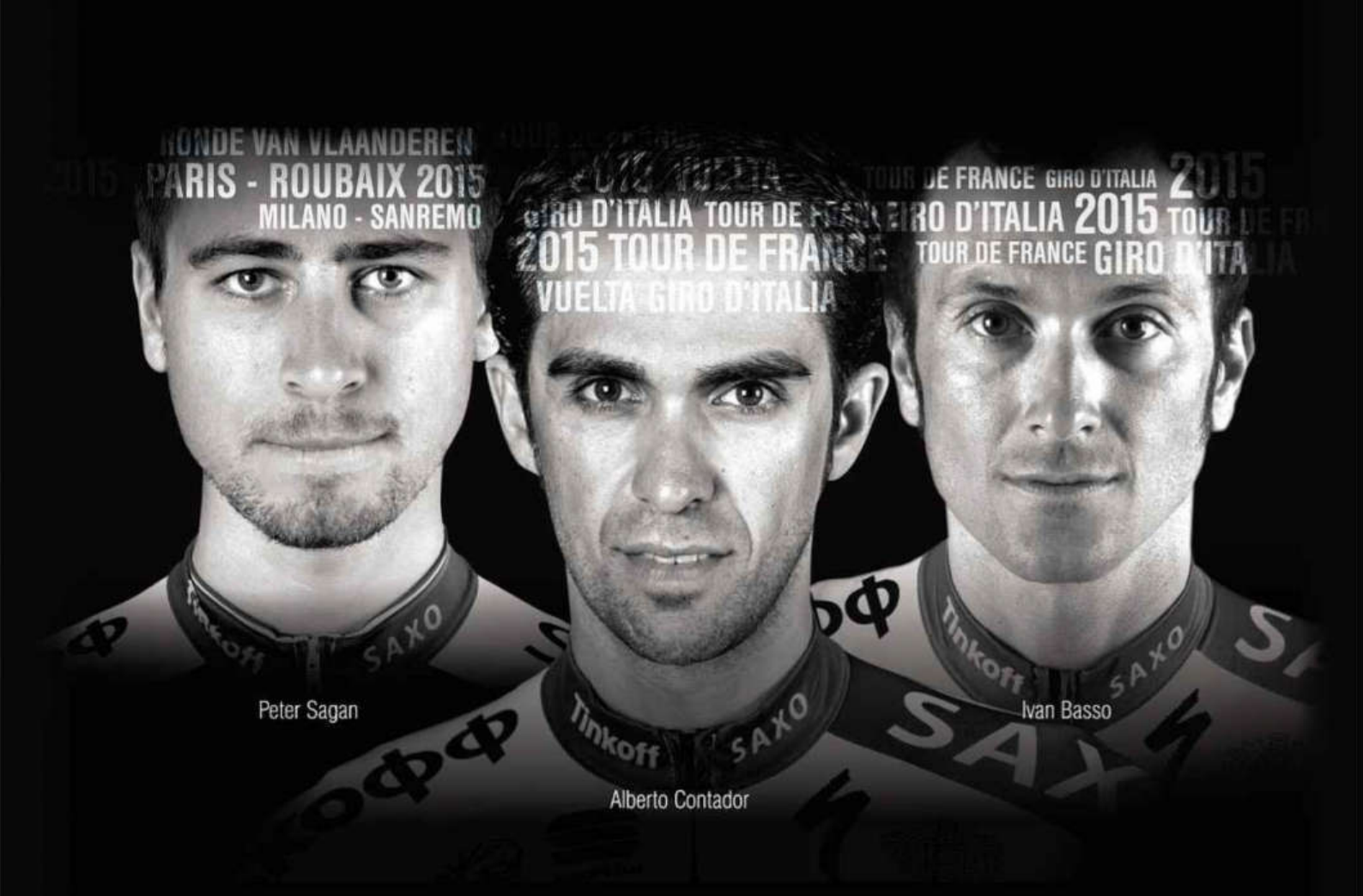
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ED'S LETTER

Cyclist
November 2015 // Issue 41



Photo Alexander Rhind

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Cyclist **meets David Walsh, the journalist who sought the truth about Lance Armstrong and whose story has been turned into a movie**

I received an intriguing letter recently. It was from the producers of the new James Bond movie, *Spectre*, requesting permission to use *Cyclist* magazine as a prop in one scene. This is absolutely true by the way – and of course I consented with enthusiasm. No sooner had I responded than I immediately started imagining how our humble journal might be inserted into the plotline...

It's late at night, and Bond is entwined with a beautiful Russian spy in his luxury hotel room. Suddenly a Spectre assassin crashes through the window and lunges at our hero. With his trusty Walther PPK out of reach, Bond grabs the nearest thing to hand – a copy of *Cyclist* magazine that he always keeps by the bedside. Rolling it into a neat tube, he dispatches the henchman with a swift blow to the jugular.

'Looks like you've been dropped, old boy,' he mutters, before settling into his armchair to read an insightful article on the evolution of bottom bracket standards.

Hey, it might happen, and I'll be first in the queue at my local multiplex when the film is released on 26th October. (I can't wait for the chase scene in the Swiss Alps where Daniel Craig rides a vintage Raleigh fitted with an ejector saddle.)

Before then, fans of cycling-based movies can fill the time by going to see *The Program*, Hollywood's retelling of the Armstrong affair, based on the book by Irish journalist David Walsh. In this issue, Walsh tells us about the ongoing saga of Armstrong's lies, his thoughts on the latest allegations directed at Team Sky, and about seeing himself on screen (he's played by *The IT Crowd*'s Chris O'Dowd). You can make up your own mind about the movie when it comes out on 16th October. After that, it's all about Bond on a bike...



Pete Muir, Editor

With his trusty Walther PPK out of reach, Bond grabs the nearest thing to hand – a copy of *Cyclist* magazine that he always keeps by the bedside

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In the back of this car is a Trek mechanic and a *Cyclist* writer. The result is the latest instalment of our Tour Diary



Photo Juan Trujillo Andrades

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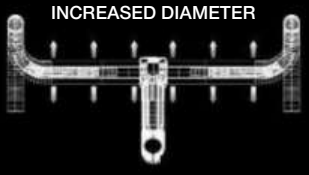


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Turn on the light

Merida reveals its latest bid for the world's lightest production bike

Words **SAM CHALLIS**
Photography **HENRY CARTER**

Merida Scultura 9000

The competition to hold the title of 'world's lightest production bike' is nearly as intense as when America and the Soviet Union raced to put a man on the moon – and it has produced similar feats of weightlessness. The new Merida Scultura 9000 has crept under the mythical 1,000g barrier for a frameset and beats Trek's 690g Émonda frame by 10g to become the lightest bike among mainstream manufacturers.

Built up with Sram Red, FSA K-Force carbon finishing kit and DT Swiss Mon Chasseral carbon clinchers, the Scultura 9000 tips the scales at a mere 5.8kg, meaning the bike that pro team Lampre-Merida rides requires a kilogram of ballast for it to be UCI legal. So how has this level of weight loss been achieved?

'In addition to a generally lightweight design and trimmed-down frame shape, this goal was mainly accomplished by using an innovative construction process with more than 400 individual carbon parts,' explains Chris Carter, director at Merida. Each was carefully placed over a plastic core, which prevented potential resin accumulation and internal wrinkles. Only then did the ultra-thin wall thickness of 0.7mm that is responsible for the frame's reduced weight become possible.

'We see this bike as a natural evolution of the Scultura,' Carter adds. 'It gave us the opportunity to push the boundaries of frame design, resulting in a bike that's not only lighter, but also more aerodynamic. It can accommodate 25mm tyres and is 20% more comfortable than the older model.'

You could expect a frame that pushes the boundaries to look pretty unusual, but the Scultura 9000 has a reassuringly normal design aesthetic.

Merida found that 'tried and tested' was often the best solution for many elements of design on the new version. 'An external seat clamp is both a lighter and simpler option than integrating a clamp into the frame. We decided to keep things uncomplicated wherever possible,' says Carter.

Despite having the ultimate goal of a super-light frame, Merida designers weren't prepared to compromise. For example, the Scultura has internally routed cables, when external cabling is believed to be the lightest option.

'Aerodynamically and aesthetically, internal routed cables are a better option,' says Carter. 'The bike is called Scultura, which is Italian for sculpture, and it's meant to be an object of beauty, so going back to old-school external cable routing would be wrong.'

The aerodynamic qualities of the Scultura are something Carter is keen

Merida Scultura 9000, £7,500, merida-bikes.com



to highlight: 'Wind-tunnel testing and CFD analysis were both used, as well as a breadth of experience gleaned from the development of the Reacto, Warp TT and our many other carbon models. We were aware that improving aerodynamics had to result in more teardrop profiles, but that requires more material and increases weight. Therefore the Scultura's tubing profiles are noticeably more aero shaped than before, but feature greater truncation in order to keep the weight down.'

Merida also created its own 27.2mm diameter seatpost for the Scultura, which not only keeps weight down,

'The bike is called Scultura, which is Italian for sculpture and it's meant to be an object of beauty, so using external cabling would be wrong'

but also increases comfort, according to Carter. This is aided by repositioning the rear brake behind the bottom bracket, eliminating the need for a brake bridge and allowing more flex in the seatstays.

Having addressed weight and comfort, Merida then had to consider the next problem – stiffness.

'A carbon frame's tensile strength or torsional stiffness isn't impacted by the wall thickness, as long the surface quality is high and the fibre selection suits the application,' says Merida's head of design, Juergen Falke. 'The minimalist wall thicknesses only cause potential problems if they need to withstand a high puncturing pressure such as during hits by sharp-edged objects, or with loads from the clamps of a workstand, for example. With the normal range of forces exerted during pedalling and riding there's no problem.

'The top-level Scultura CF5 frame of the Scultura 9000 has just passed the "Zedler Advanced Plus" lab-test in Germany – the highest independent fatigue strength lab-standard test available for road frames in the industry.'

It's no surprise that some riders from Lampre-Merida are requesting to switch from the Reacto to the Scultura for the 2016 season. The Scultura has been validated by WorldTour pros, but how will it fare with *Cyclist*'s testers? Look out for the review next issue.





Sportful Fiandre

Extreme Neoshell Jacket £250, NoRain Bibtight £125, Glove £70, c3products.com

Fiandre is Italian for Flanders, a nod towards the tough conditions this kit is designed to thrive in. The entire outfit is new and, whereas previously the Fiandre line was made for autumn and spring conditions, this latest gear is designed purely for winter.

Tinkoff-Saxo team members have had input to the design, as has Polartec, Sportful's fabric partner for its sister ski-wear brand, Karpos. The Fiandre uses Polartec's Neoshell fabric, which is waterproof, windproof and highly elastic to provide a form-fitting, non-restrictive garment. Extra waterproofing is provided by No-Sew finishing on pockets, hem and cuffs, plus fully taped seams. The fabric's claimed high breathability should help prevent a boil-in-the-bag scenario, too.

The bibtights feature a brushed thermal lining and use a double layer, created with a lighter version of the Fiandre NoRain fabric and added as a barrier to icy spray. It protects your backside and lower back, plus the thighs and knee area. The gloves are fully waterproof, with plenty of thermal insulation too, but crucially with very little bulk to maintain dexterity.



Equinox Typhoon-x 45 Clincher

£1,765, equinoxcarbonwheels.co.uk

Equinox is a joint venture with Gigantex, one of the biggest carbon composite producers in the industry that manufactures wheels for various brands,' says Equinox Wheels UK importer, Ian Gilkes. Indeed, *Cyclist* first came across this design several years ago at the Gigantex booth at trade show Eurobike, and even then we thought the Typhoon-x design had some obvious benefits over other full carbon-spoked wheels.

In most cases where wheels are built with carbon spokes, the spokes are bonded to the rim and hub, meaning they have to be returned to the factory for spoke replacement or repair. On the Typhoon-x, spokes can be adjusted and replaced by the owner or a local bike shop mechanic.

The spokes themselves are threaded at one end as with traditional metal spokes, and screw into nipples hidden in the rim (the part you can actually see are in fact silicone rubber covers to stop water getting into the hollow rim, says Gilkes). Look out for a full review in the coming months.

Rapha Cross long sleeve aerosuit

£230, rapha.cc

As autumn leaves begin to fall, thoughts turn to the muck and glory of the cyclocross season. With that in mind, Rapha has released a new range of cross-specific attire, of which this aerosuit is the centrepiece.

'Input from USA Cyclocross Champion Jeremy Powers and the Rapha Focus team prompted key features on the suit,' says Rapha's Laura Bower. 'For instance, we've included shoulder reinforcement to add protection when carrying the bike, a single pocket to house a bidon for your warm-up and a perforated chamois to deal with the heat of high-intensity races.'

The jazzy colourway is designed to reflect the informal atmosphere of cyclocross, while the kit's quality has not strayed from Rapha's usual ethos, so you should finish the season as impeccably dressed as you started it. Rapha has its own Super Cross Series, starting at Shibden Hall, Yorkshire on the 17th October – a perfect opportunity to test your new suit.



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Tacx Neo Smart

£1,200, fisheroutdoor.co.uk

Tacx pioneered the first electronic turbo trainer in 2001, but now it has ripped up the rulebook, eliminated the belt and removed the flywheel. What's left? The Neo – the first 'true direct drive' turbo trainer.

The cassette body on the Neo is attached directly to the magnets of a 'virtual flywheel' without additional moving parts, so Tacx claims it's the quietest turbo trainer on the market. Turn the cranks and the electronics in the virtual flywheel measure your pedalling forces up to 1,000 times a second, adjusting the ride feel to suit riders up to 125kg. It can also calculate your cadence based on your pedal inputs, and has the capability to dish out up to 2,200 watts of resistance and simulate slopes up to 25%.

The really smart bit of the Neo is its connectivity. It uses ANT+ and Bluetooth to connect to computers, tablets, phones and Garmins without requiring an external power source. It also works with virtual reality programs including Zwift, TrainerRoad and Tacx's own app, although it does have to be plugged into the mains to simulate descents. When attached to a Garmin it can even simulate previously ridden courses. Should you decide to bypass all this and escape the data frenzy, the Neo can simply be used as an old-fashioned trainer or *Star Wars* prop.



Lezyne Mini GPS and Super GPS

£110/£160, upgradebikes.co.uk

With the world of GPS computers dictated by monolith-like conformity, accessory brand Lezyne saw an opportunity to make use of its fetching aesthetics. Behold the very tiny Mini GPS and the slightly bigger Super GPS. The Mini GPS may be small (33.4mm x 50.8mm, about the size of a matchbox) but it is an entirely self-contained unit, albeit without wireless connectivity. The Super GPS version (46.5mm x 73.2mm) has Bluetooth and ANT+ allowing it to read heart rate, cadence and power meters as well as highlight incoming phone calls and texts on screen.

Lezyne is particularly proud of the closure system with the new X-Lock, which requires a push and twist to mount the unit and is virtually immoveable once locked in.



Zipp Transition 1

£132, zipp.com

If organisation before an event isn't your strong point, Zipp has designed the Transition 1 bag with a place for everything. You can customise how you divide up the main compartment to separate your kit, removing the need to tip everything out to find what you want. It's water resistant to make sure your gear at least arrives warm and dry, and the bag is topped with an EVA hard case to protect delicate items. At the sides are bidon pockets, while on the front is a nifty helmet carrier. Underneath is a well-ventilated soft divide for wet shoes or sweaty clothing.



Specialized S-Works 6 shoes

£280, specialized.com



Ever wondered how accurate those little marker lines for cleat position are on the soles of your shoes? Ever wondered how accurate the sizing of your shoes is full-stop? Well, Rob Cook, the man behind the latest S-Works shoes, claims to have the answer: 'Not very. For example, the hand processes used in many shoe's manufacturing can affect the fit of the girth by 6mm for the same size. Many of these hand processes such as cutting and gluing produce margins of error, so the primary goal for our new shoe wasn't just fit, but consistency.'

Specialized automates as many of its manufacturing processes as possible. The materials are laser-cut, and the PadLock heal enclosure is minutely jigsawed to interlock with the carbon sole. Then there's the cleat mounting. 'Cleat holes are 100% accurate shoe to shoe,' says Cook. 'Even the cleat position markers are laser-etched.'

Cyclist can attest to the finish and comfort of the S-Works 6 (although this is subjective of course), as well as the weight – Specialized claims 224g for size 42s. The Boa closures are a fine addition too, however for those into laces and lightness, a 'Sub6' version is available for £250, weighing 194g.



Campagnolo EPS V3 battery and interface

£448.62/£165.20, chickencycles.co.uk

Shimano owners look away now – this is only really for hardcore fans of Italian shifting. Campagnolo has updated its Record/Super Record interface unit with wireless connectivity and more aerodynamic casing. This V3 version will link to a forthcoming app that allows riders to fully customise button function and elements such as shift times/patterns. A slimmer battery means it can now be fitted to a wider variety of framesets, including those narrow-tubed aero numbers.

Garmin Varia light

£159.99 (tail light), £239.99 (with radar display unit), madison.co.uk

According to Garmin, over 40% of cycling deaths result from being hit from behind, which is why it has produced the Varia Rearview Radar tail light. The unit detects an approaching vehicle from as far away as 140m and automatically increases its brightness and flashing intensity as the vehicle gets closer. Plus, used in conjunction with the optional radar display unit (or a Garmin Edge 1000), a visual warning turns from green to amber and finally to red as the vehicle closes in.



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Knock your socks off

In a sea of plain-coloured kit, let your socks make a statement

Words **SAM CHALLIS** Photography **HENRY CARTER**

There was a time when there was no argument about socks. You wore white socks with a cuff sitting just above the ankle. That's what Coppi wore, and Anquetil and Merckx and all the rest – so that's what every cyclist wore. Then along came Armstrong and ruined it all with his long black socks. Since then it has become a free-for-all, with different lengths and colours being flaunted with little regard for the heritage of our great sport.

Despite our obvious horror at some of the sock crimes being committed, we're all in favour of the latest trend, which is for brightly coloured and patterned 'statement' socks. When paired with plain kit, and maybe matched to other details such as shades or bar tape, the bold art-sock can make the whole outfit look truly fantastic.

'The socks maketh the kit,' says Sean Sakinofsky, creator of Sako7 socks. 'The style of your socks is really the finishing piece to your kit – they can make bad kit look good and vice versa. Anything less than a four-inch high cuff is a no-go – there isn't enough space for the designer to create their work of art.'

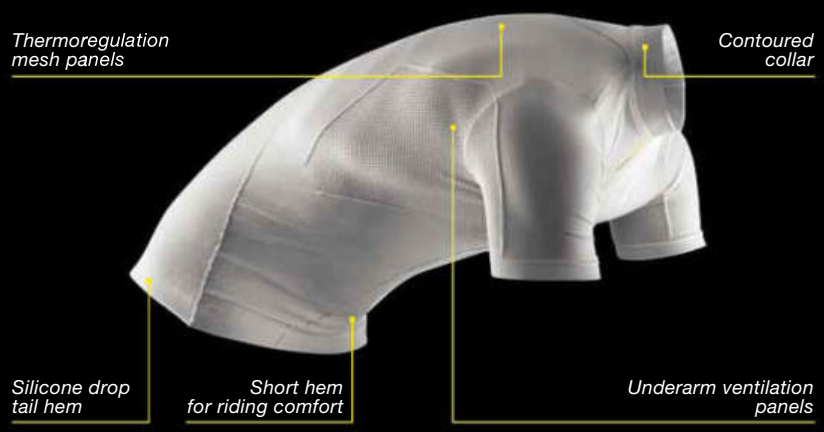
Expect to see more and lairier sock designs in the near future, but for the moment here are a few of our favourites.

See p176 for stockists




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With an Hour record and a Tour victory this year, Pinarello is the brand of the moment. *Cyclist* met its owner to discover the secret of its success

Words **JAMES SPENDER** Photography **MIKE MASSARO**

Cyclist: When did you first start building bike frames for a living?

Fausto Pinarello: My father, Giovanni Pinarello, started Pinarello Cicli in 1953 after his racing career, and I came to work for him in the 1980s when I was 17. My first job was painting frames. When you are kid you're not the man, you are the boy, and the paint shop was easier for a young guy. But I was stimulated – I'd see the product on television and say, 'I did this one!' Over the next eight years I went through to chroming, welding, assembly, but it wasn't until I was 25 that I decided that this was my future. When we started the business there were only six or seven people. Now we have more than 50 staff on the books and I'm the oldest one of them all!

Cyc: With carbon fibre dominating these days, do you miss steel?

FP: When I started making bikes all the frames were the same – round steel tubes. The only difference was the type of tubing and the paint. Then the steel frames with the lugs moved to TIG-welded frames, then to aluminium, titanium, we did magnesium too, then carbon fibre. Steel is more traditional and more stylish maybe, but carbon fibre is a very important material. It will be the top for many years to come. Maybe there will be new types of composites, but still with carbon fibre.

Cyc: How much involvement do you have with designing the bikes now?

FP: I sign everything off. If I don't like the bike, I don't sign. I say sorry, no. But it's easier to make a good bike now, because we've been making good bikes for so long that you are starting from the base of the last model you made, which was already good. It's easier than 20 years ago. Then we would create a new bike with new technology before taking it to the wind-tunnel, but then you need the numbers. If the bike is OK then the numbers are your friends. But if not...

Fausto Pinarello inspects one of his own creations at The Bike Rooms on Regent Street, London

Cyc: So you were working in wind-tunnels as long ago as the 1990s?

FP: Yes, we started talking about aerodynamics in 1993 with Miguel Indurain for the *record dell'ora* [Hour record]. I think we're the only brand in the world who has won the Hour record twice, once with Miguel and then with Bradley. When we went to the wind-tunnel back then, it was something new. We said, 'Let's go! Let's put Miguel in the tunnel.' Then I started to learn about aerodynamics. Twenty years later we're working with Jaguar. We're partners with Team Sky like Jaguar is, and we are trying to create a synergy between us to make the best possible product for the rider. The automotive industry, they're a little bit more expert than us, as cars need to be more aerodynamically advanced to make them more efficient to save gasoline. We don't use gasoline, we use human energy, but the result is the same. With Jaguar we started out with the Bolide [Pinarello's flagship time-trial bike] and then took it to the track, removing the derailleurs, the brakes, the bottle cages, and making it faster and faster. I'm not sure that there's another bike in the world as fast as Bradley's Hour bike.

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'I texted Wiggins 10 days before the event to ask him how the bike was. He said, "I've never ridden with this kind of bike. It's simply perfect." I said, "OK, let's go!" He's an incredible rider'

Cyc: Did you speak to Wiggins before the event? Ever offer him any advice?
FP: Yeah, of course! I texted him 10 days before to ask him how the bike was. He said, 'I've never ridden with this kind of bike – it's simply perfect.' I said, 'OK then, let's go!' He's such an incredible rider. It's not just about the bike, it's also about the legs and the rider. His riding position is so aerodynamic and fast.

Cyc: How many different bikes do you have in your garage at home?
FP: I have three in the same colours: white and yellow fluoro. The yellow is my favourite – it's the colour of my business cards. I have one F8, one K8-S and one disc brake F8. But I change bikes every two weeks. It's my job.

Cyc: The K8-S, with its rear suspension, is an interesting bike. We have seen suspension before at Paris-Roubaix back in the 1990s, but it didn't catch on. Why have you brought it back now?
FP: Jaguar was working on an SUV and testing the suspension over cobblestones. One of their guys said that when you ride a bike on cobblestones it must be like a bomb going off, and you can't even begin to think about how much power you're losing, so he said we should use suspension. Their numbers showed that we only needed suspension at the rear if we created special geometry – longer and more laid back with the rider weight back – so that they float over the cobbles, like a boat on the water.

Cyc: Do the Team Sky riders have a say in what bikes you make for them?
FP: Yes, a lot, day after day. Our first question to them is always, 'What do you want?' The most important thing is the geometry. We haven't changed ours since 2007 with the Prince, as I think its geometry is perfect, and it comes in 13 different sizes. Maybe the head tube is shorter, but the angles are the same. But for stiffness and things like that, it's all about the rider feedback. Not many teams can give the very important feedback like Team Sky. We could sponsor four other professional teams for the same money, but Sky is the best in the world with the best feedback. We now also have Dimitris Katsanis working exclusively for us for the next five years. He's a very sharp guy who used to design bikes for British Cycling [as part of Chris Boardman's 'Secret Squirrel Club'].

Cyc: Do they all get custom sizes? How do the rules restrict what you can do?
FP: No, the rules from the UCI say that the riders must be using the same frame you can buy in the shops. Except in the case of Cav. He has shorter legs, but a long back, so we made a special bike for him that was a little longer like he wanted. We call it 'Cavendish size'.

Fausto Pinarello with the Giro d'Italia trophy

Cyc: Who has been the most exciting rider you've ever worked with?
FP: Miguel was the man. He still rides our bikes. Erik Zabel was good, Antonio Flecha, Bradley Wiggins and Bjarne Riis.

Cyc: Riis was known for being very focused as a rider wasn't he?
FP: So focused – too much! He has had his problems, but he did a great job for us from the technical side: the bicycle, the pedals, the stem – power meters. It was Riis who first introduced me to SRM [The SRM power meter]. He was the man for small details. He was so good.

Cyc: Are there other companies in the bike industry that impress you?
FP: There are many big companies, but they are more big than good. I'm sure that some of them are doing a good job, maybe, but I can say one thing – in the last six or seven years they are doing a good job, but they are not me. I put more passion into my bicycles than 10 of those companies put together. They make a million bikes a year, but there is no sentiment behind them. People that buy my bikes are the kind of people that have a Ferrari in the garage and a Pinarello, but they say, 'I prefer the Pinarello.' I met a man recently who has bought 31 of my bikes. American brands and Taiwanese brands can't say that. I know a designer from Ferrari who came to visit the factory because he'd bought two bikes from me. He said, 'Wow, Mr Pinarello.' I said, 'Come on, you work for *Ferrari!*' That is the exciting thing. But they love the company. I create the best bikes I possibly can because of me.

Cyc: Are you ever frustrated with the UCI rule book when it comes to bike design?
FP: In 1994 we were an isolated brand. The UCI came to us and denied us permission for Bjarne Riis and Jan Ullrich's bikes to be raced [they were heavily faired, Y-style frames]. They said, 'Stop it, stop this shape. It is too aerodynamic!' Because of that, the rules now are that bike frames need to have two triangles. They said there should be no rear tail on the bike, so we said we would cut off the back of the tail, and they said, 'Oh you can use it now.' *Argh!* They are more open to ideas now than 20 years ago, though. Now we ask for 10 things and they give us one. In the past we asked for 10 and we'd get less than zero! Wow, look at that car! [Pinarello points to a Porsche that has just driven past the window.]

Cyc: What, that Panamera? With five doors? Shouldn't all Porsches only have a maximum of three doors?
FP: Maybe, but those guys were young and I am old, so I have a Panamera. How come? I can't get my bike in a 911.

Cyc: But what about with a roof rack?
FP: That's not aerodynamic!

'People that buy my bikes are the kind of people that have a Ferrari in the garage and a Pinarello, but they say, "I prefer the Pinarello." I create the best bikes I possibly can because of me'

'A designer from Ferrari came to visit the factory because he'd bought two bikes. He said, "Wow, Mr Pinarello!" I said, "Come on, you work for *Ferrari*!"'



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How much better are the pros?

We know pros are superhuman, but exactly how much better are they than the average cyclist?

Words **JAMES WITTS** Illustrations **ROB MILTON**

The Etape du Tour, the annual amateur event that follows one of the key mountain stages of the Tour de France, lends us mortals a rare opportunity to make direct comparisons between the pros and ourselves. This year's Etape route was the 138km alpine stage 19, from Saint-Jean-de-Maurienne to La Toussuire-Les Sybelles, which included an ascent of the fearsome Croix de Fer.

The first rider across the line in the amateur sportive was France's Jeremy Bescond in 4h52m44s. Five days later Vincenzo Nibali took the spoils as the Tour passed through, covering the stage in 4h22m53s at an average speed of 31.5kmh – that's 11% quicker. Of course Nibali had the assistance of his team and other riders around him (although on this occasion no obvious use of the team car's wing mirror), but on the flipside, Bescond was himself a pro rider until recently, as were a good chunk of the top 10 finishers in the Etape.

However, fifth overall in the Etape was France's William Turnes in the 40-44 age category, and he's likely to be the first *real* amateur to cross the line, finishing in 5h02m56s, 15% slower than Nibali. The last place finisher on Stage 19 of the Tour was Katusha's Jacopo Guarnieri, in 4h53m23s, 12% slower than Nibali and perilously close to being excluded by the stage time cut-off.

To put this into context, Guarnieri is a sprinter who was doubtless conserving energy for the final yards in Paris, and who already had over 3,000km of racing in his legs. Yet he still managed to complete the course nearly 10 minutes ahead of the best-placed amateur rider who was no doubt giving everything he had for a single day.

The last male finisher at the Etape took 12h46m07s, nearly three times longer than Nibali, but perhaps a more representative measure of the average rider would be to take the half way point (the median) of the finishers. That was the rider in 4,986th position, David Hall, who finished in 8h49m07s – 101% slower than Nibali. By this account, we might say that pros are, on average, twice as good as the rest of us. But there are other ways of measuring ability...

Amateurs can compare themselves to the pros on the Etape du Tour, but to get near them you need to excel in several aspects of fitness: VO_2 max, threshold pace and power, to name three

Superhuman physiology

Completion times give a good indication of relative performance, but what about comparing our physiology with the pros? VO_2 max is a measure of the maximum amount of oxygen you can use each minute. Theoretically, the more oxygen you can use, the more energy you can generate to fuel muscles. It's measured in millilitres per kilogram of bodyweight per minute (ml/kg/min).

'Your average sedentary office worker comes in with a VO_2 max at the 30-40ml/kg/min mark,' says Matthew Furber, senior sports scientist at the GSK Human Performance Lab in London. 'Once you reach around 60, we're talking category 3 riders, maybe category 2. Cat 1 riders are usually over 70 and beyond.' So what about the pros?

Greg LeMond registered 92.5ml/kg/min, going some way to explaining how the American legend racked up



André Greipel has been recorded to peak at more than 1,900W during a sprint and can hold an average in excess of 1,000W for 30 seconds

three Tour de France titles. Even more impressive is Norwegian cyclist Oskar Svendsen, who registered the highest-ever VO_2 max across any sport in 2012 at 97.5ml/kg/min. Some other famed names and their VO_2 maxes: Lance Armstrong 84, Miguel Indurain 88, Thor Hushovd 86.

If we consider our cat 3 rider with a VO_2 max of 60 as 'Mr Average', the top pros (at around 80) have an advantage of 33% in oxygen processing terms. But having a high VO_2 max value alone is not enough to be a star rider. WattBike creator and sports scientist Eddie Fletcher says, 'What's more important is how long you can sustain a high percentage of your VO_2 max.' Which brings us on to threshold.

A rider's lactate threshold is the maximum steady-state riding intensity they can maintain without a significant build up of lactate. In other words, it's the tipping point beyond which your body will rapidly fatigue to exhaustion.

Professor Inigo San Millan compared the blood lactate figures of riders ranging from junior cyclists to amateurs to world-class. The data revealed that at a power output equal to 3 watts per kilo (W/kg), amateurs produced 37.5% more lactate, but nudge the power up a bit to 3.5W/kg and suddenly the figure jumped to 62.5% more. At 5.5W/kg (that's kicking out 412W for a 75kg rider) the grimacing amateurs were producing 77% more lactate than the pros.

Power, power, power

Measuring physiological prowess in the lab is one thing, but when it comes to making comparisons out on the road, it's all about power output. Even more so since the media storm surrounding Chris Froome's second Tour victory, which saw Team Sky release his power files to provide greater transparency about his performances. Froome's data reveals an average power output of 414W for 41m28s, equating to 5.78W/kg, with Froome weighing 67kg. Team Sky's head of athlete performance, Tim Kerrison, also revealed that Froome regularly exceeds a 30-minute power output of 419W (6.25W/kg) and for 60 minutes he would expect to ride at or above 366W (5.46W/kg).

Also in the spotlight recently were statistics from Tom Dumoulin's impressive Vuelta a Espana performances. Dutch Newspaper *AD* published an article revealing power statistics for key stages of this year's race. Stage 6 showed Dumoulin rode an average of 508.2W over a climb lasting 5m55s, equating to 7.0W/kg.

Let's give all these figures some context. Box Hill in Surrey is the most popular Strava segment on the planet, and to place in the top 10% of Strava times you will need a time ahead of Roki Read (who sits around 4,800th place). A decent club level, amateur cyclist, Read's time of 7m09s at an average 310W equates to 4.19W/kg – that's 60% of Dumoulin's output over a similar duration.

If you fancy yourself as more of a sprinter than a climber, then German powerhouse André Greipel has been recorded to peak at more than 1,900W during a sprint and can hold an average in excess of 1,000W for 30 seconds. The more aerodynamic Mark Cavendish has been said to hit around 1,600W in the charge to the line. It sounds like a lot, and it is. *Cyclist*'s resident crit racer Peter Stuart (a former GB rower) hits a peak of 1,050W in the sprint (55% of Greipel) and can hold 600W for 30 seconds (60%).

So how much better are the pros? It depends on which metrics you use, but a competitive amateur is doing very well if they can get within 60% of the world's best. That last 40% may involve a considerable amount of marginal gains.



You're doing well if you can get within 60% of the best cyclists in the world – but it might leave you flat on your back



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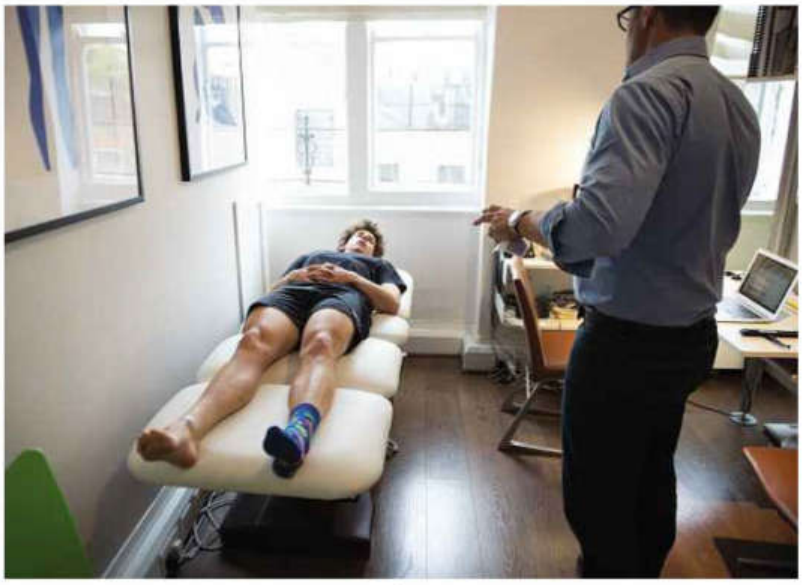
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Fuel economy

Will manipulating your metabolism make you a better rider? *Cyclist* investigates

Words **SAM CHALLIS** Photography **GEOFF WAUGH**

A consultation with Laurent Bannock, and expert in metabolic efficiency, can help riders go further, faster

In the land of cycling nutrition, carbohydrate is king. It provides the quick hit of energy required to get riders through the interval sessions that we're told we need to build power and speed. The result is that we have become loyal subjects to the mighty carbs, and our bodies have become reliant on them for fuelling our rides. But it could be that we are serving the wrong master.

Broadly speaking, the average cyclist carries enough glycogen (carbohydrate stored in the muscles) to fuel about 90 minutes of activity – barely enough to get most riders to their first cafe stop. Further, carbohydrate oxidation (ie burning energy) has a strong correlation with lactate production, which limits performance. So to improve, we need to become more metabolically efficient, which is why *Cyclist* has come to Guru Performance in Mayfair, London, to see Laurent Bannock, a scientist at the forefront of metabolic efficiency training.

All hail fat

'Metabolic efficiency is the ability of an individual to utilise their most significant on-board fuel supply – body fat – for as much of the exercise duration as possible,' Bannock says. 'Fat is the most sustainable energy source for an athlete, and delays the accumulation of lactic acid by sparing glycogen stores. However the situation is complicated by the fact that an athlete must also be metabolically flexible – able to switch rapidly and proficiently between the body's fuel sources to match the fluctuating intensities of competitive events. Don't worry, we'll revisit this later,' he tells me with a grin, as if sensing my growing incomprehension.

He then asks me to remove my right sock and lie back on his examination table. Bannock explains that a host of anthropometric details are needed before we get to the crux of the testing. 'This is a fluid balance test to determine intra and extracellular hydration,' he says as he attaches electrodes to various points on the right side of my body. 'It's critical to understand the context in which metabolic results are achieved. Think of metabolic efficiency as a GPS signal – each auxiliary test is a satellite, and more satellites create a more accurate signal.'

Dehydration, as well as having other detrimental effects, increases the rate of muscle glycogen usage, therefore reducing metabolic efficiency. By testing for adequate hydration, this factor can be removed to ensure we get a true measure of my metabolic efficiency. This same logic is applied to the rest of my assessments, which include body composition analysis via a skinfold test. 'Despite being the source of energy we're trying to tap into, most body fat is unnecessary and is non-functional weight that serves as a primary limiting factor of performance,' Bannock says.

Saliva, blood and urine samples are taken, determining among other things my immune function. Poor immune function helps point towards high stress levels: another hindrance to metabolic efficiency. 'Stress causes the adrenal glands to secrete adrenaline, which tells the body to burn more carbohydrates – it's the fight or flight response, but is detrimental to endurance performance,' says Bannock. Despite having a busy job, my stress levels appear reasonable. With a



complete set of accurate results, I can move onto the main tests.

Now for the hard bit

The expected sweat and pain is postponed by 10 minutes as I am required to sit still while a Bane-style mask collects details of how much fat and carbohydrate I burn and what ratio of oxygen and carbon dioxide I inspire and expire at rest – ultimately determining my resting metabolic rate.

According to the test, I naturally burn 2,724kcals a day, which is some 500kcals higher than the estimated daily requirement of 2,192 for a person of my height and weight. 'Knowing this is incredibly important,' says Bannock. 'It highlights the individual variability that exists in metabolic testing. You're a long way off average so working off a wrong value can have a profound impact on adaptation to metabolic training. To go back to the GPS analogy, this is another integral satellite.'

The time has finally come to hop on the static bike. I'm following a hybrid protocol developed by Bannock that's adapted from standard 'fat max' and metabolic efficiency tests, but also includes metabolic flexibility parameters. It's a stepped protocol starting at 100 watts, increasing by 40 watts every five minutes until I reach a 'substrate crossover' – where the intensity is such that my body has no choice but to switch from burning mostly fats to mainly carbs.

Pre-assessments include hydration analysis (right), body composition (below) and how many carbs *Cyclist* burns at rest (bottom). The results combine to give an overall picture of metabolic efficiency





The intensity is such that my body has no choice but to switch from burning mostly fats to mainly carbs



Master your metabolism

Five ways to improve your metabolic efficiency

Periodise your diet

Eat less carbohydrate on rest days and more on training days. Carbs are used to fuel high-intensity exercise – on rest days you don't need as many carbs because you don't expend as much energy. This decreases your body's reliance on them.

Chill out

Being stressed raises adrenaline levels, forcing your body to burn more carbohydrates at rest. Get a massage, take a nap... do something that relaxes you. This will decrease your adrenaline and allow your body to burn fat more easily.

Train fasted occasionally

Before breakfast your muscles have less glycogen in them. A couple of hour-long spins a week, early in the morning, will force your body to use its fat stores for energy. Take it easy though – you want to burn fat, not break down muscle.

Watch the sport drinks

Avoid using sports nutrition products when training at low intensity. Carbs are the body's preferred energy source – consuming gels and energy drinks will cause your body to stop burning fat and become dependent on carbs for ride fuel.

Mix it up

Intersperse low-intensity, high-volume rides with interval sessions. This will keep your body guessing and help prevent a progress plateau, familiarising your body with burning fat for fuel but also training your top-end speed and lactate threshold to keep you competitive in sprints.

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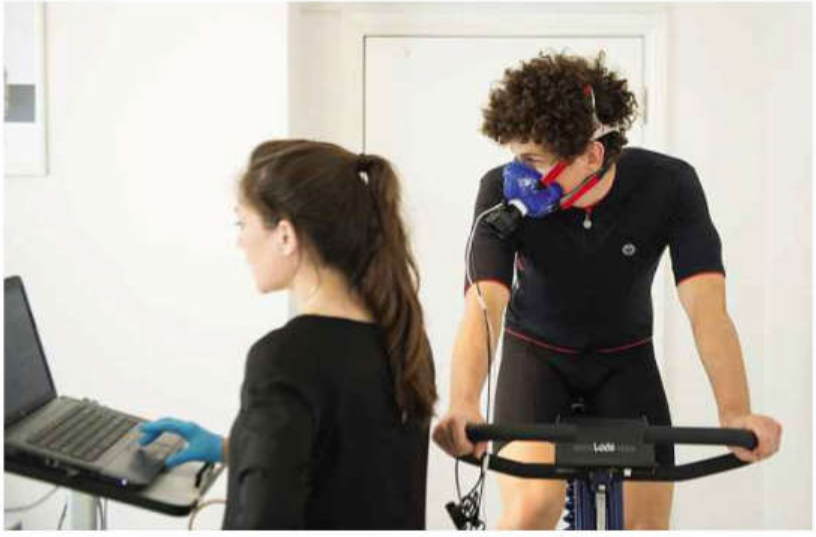
The test starts innocuously enough: I see on the screen to my right that the five-minute blocks are slipping by with little change in my physiological parameters. However, at 260 watts I really start to notice the work rate and the graph displaying my substrate utilisation shows that fat oxidation is starting to fall, with carbohydrate rising to take its place.

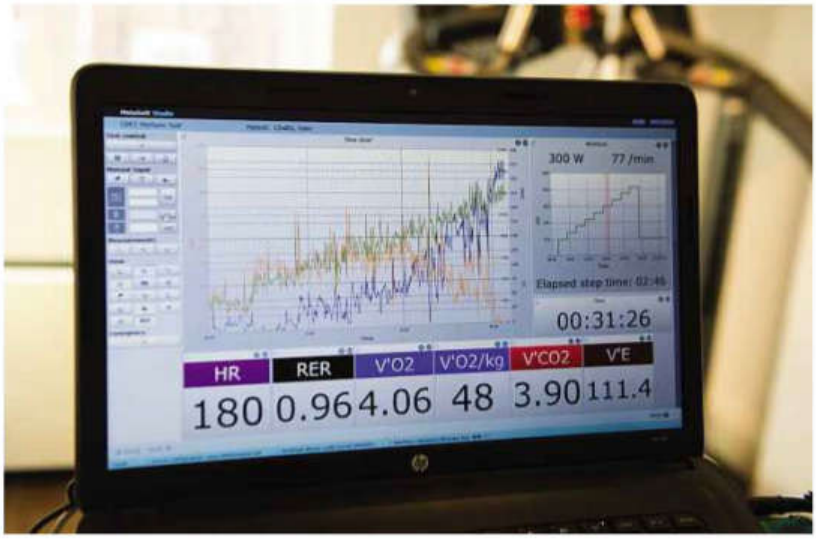
Until now the finger prick blood samples to test lactate have been tricky to collect, but now my thudding heart forces blood out of my finger with relative ease as the target power rises to 300 watts. Midway through this block the substrate graph shows my fuel utilisation has clearly switched, so with relief I hear the call that no further increments are necessary.

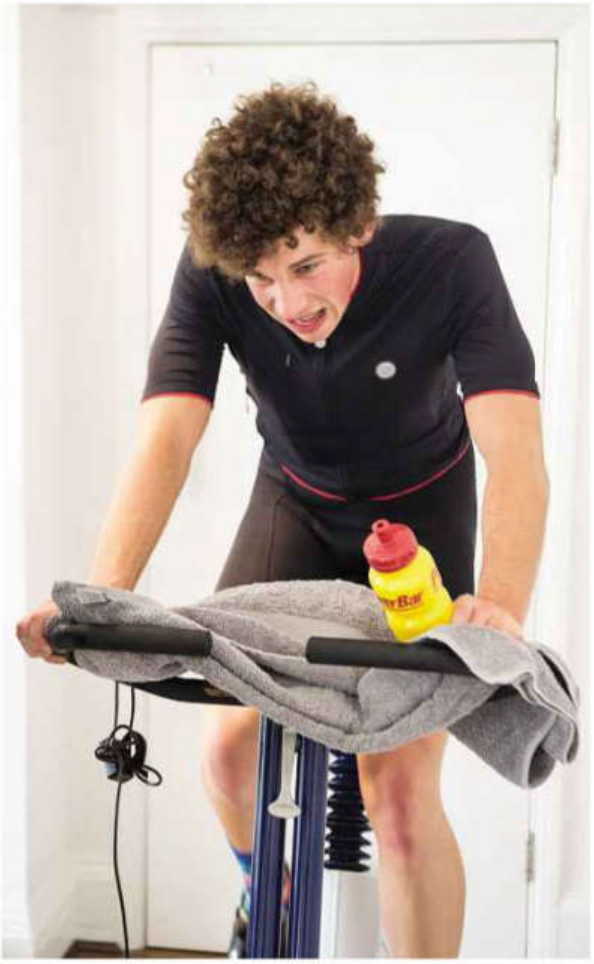
From my data Bannock has a clear idea of my metabolic efficiency: 'It's good but there's room for improvement.' It can be seen that keeping a power output of around 220 watts, or a heart rate of 150bpm, would allow the bulk of my energy to come from fat, drastically increasing time to fatigue. This gives me a clear target to aim for during training, but it seems I might need to rethink my behaviour off the bike.

'Ideally there should be a clear switch on the substrate chart, which there isn't particularly, and you should be burning less carbohydrate at rest than you do, suggesting you eat too much of it,' says Bannock. 'But as a non-competitive cyclist, your metabolic efficiency is most important – your metabolic flexibility only becomes a pressing issue in races where the need to switch between fuel sources helps you respond to changes in pace most effectively.'

At 260 watts I really start to notice the work rate and the graph shows that fat oxidation is starting to fall, with carbohydrate rising to take its place





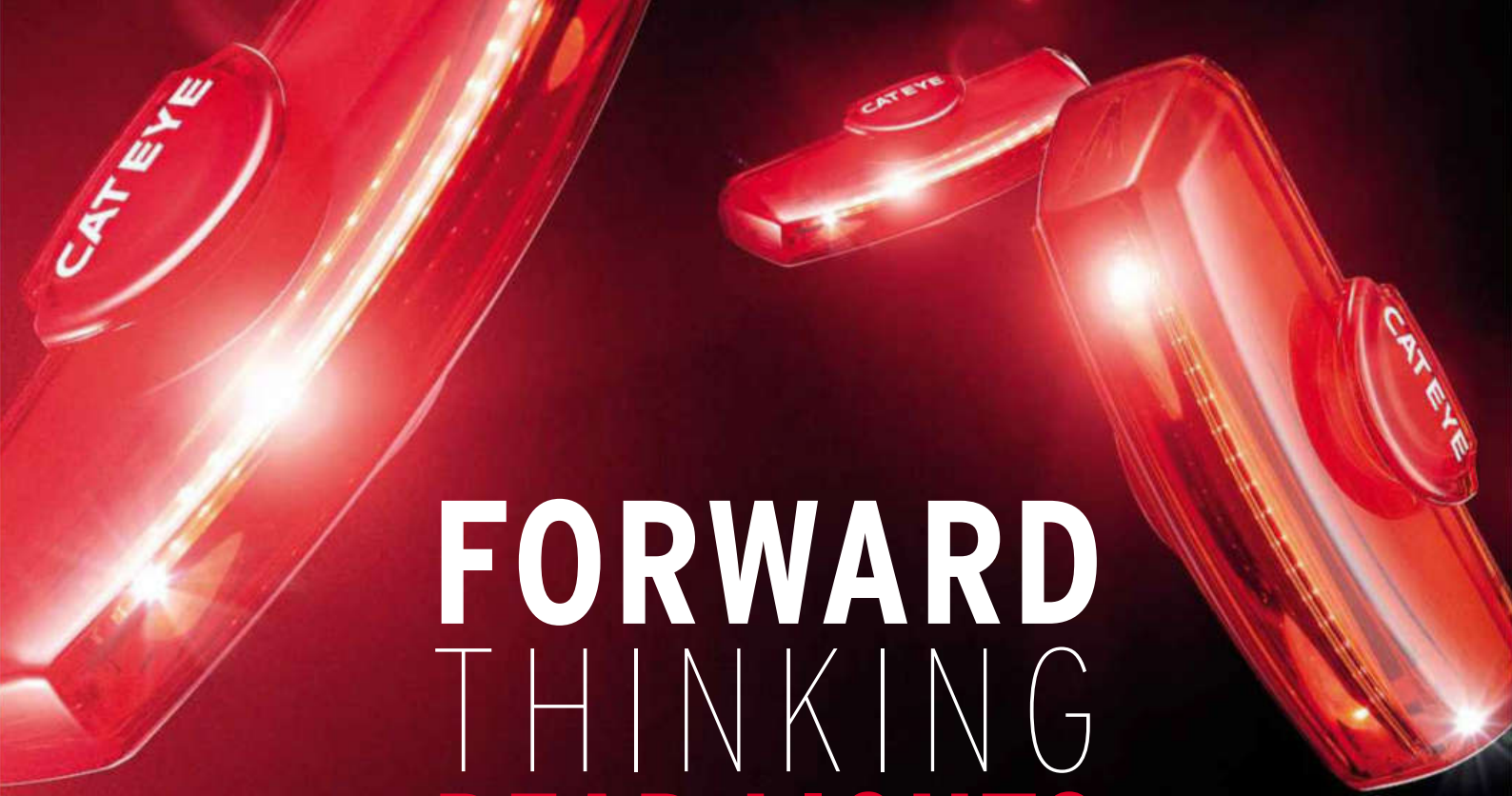


As *Cyclist* works harder and harder on the bike, the data on screen pinpoints the switch from fat to glycogen as the main source of fuel

So where do I go from here? 'Periodic carb loading in response to training demands – ie more carbohydrate on training days, but less on rest days – would see both your efficiency and flexibility improve,' Bannock says. This makes complete sense; I habitually eat the same thing regardless of my activity level. 'I would also recommend training fasted occasionally too – your body responds best to variety and training with low muscle glycogen would force your body into oxidising its fat stores more readily. Changes would be tangible within six weeks – adaptations to metabolism occur as a result of consistency and frequency.'

No cake for me at my next cafe stop, then.

For more on cycling efficiency see p80



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In praise of... Cycling etiquette

You may not know which direction to pass the port decanter, but every cyclist should show good manners when out on the road

Words **TREVOR WARD** Photography **JENNI LEKINEN**

The dictionary defines etiquette as 'the customary code of polite behaviour in society or among members of a particular profession or group'. In the UK this usually involves standing around in queues, making cups of tea and holding doors open.

The dynamics of riding in a bunch are slightly more unpredictable but, in order to avoid scenes of ripped Lycra and cracked carbon up and down Britain's roads every weekend, the rules of good behaviour still apply. Etiquette on the bike isn't just about the health and safety of the riders (and other road users), it's also about the aesthetics of cycling. The etiquette of group riding not only preserves dignity and limbs, it can turn a group of disparate riders into a fluidly functioning and seamlessly shifting organism. If they're all wearing matching club jerseys, even better.

A group of riders that's perfectly in sync is a beautiful thing to behold. It doesn't have to be a high-speed chaingang or slickly executed ballet of through and off. It could be wordless gestures warning of potholes or parked cars that ripple from rider to rider (shouts should be saved for less obvious hazards such as gravel or a sudden obstacle in the road). Simply riding two abreast at tempo without any half-wheeling or overlapping can, itself, be poetry in motion.

A key to bike etiquette is clear communication. On a bike we are at one with our surroundings, exposed to the road and weather conditions, and it's a basic courtesy to other riders in our group to keep them informed of potential hazards. Vehicle drivers, cosseted in their speeding metal capsules full of home comforts such as air conditioning and entertainment systems, don't feel such an organic connection with the roads they are travelling on, and usually only communicate to each other via car horns, obscenities and threats.

Crucially, we should also always acknowledge other riders we see on the road. Climbing the Duke's Pass in Scotland last month, I waved to a rider coming down the hill. He pointedly ignored me. That's just plain bad manners. If I could manage a wave while struggling up an obstinate 10% gradient, he at least owed me the courtesy of an acknowledgement.

By acknowledging a fellow rider – no matter what their speed, age or gender – we raise ourselves above the level of other road users. We are cyclists. We enjoy the same highs and lows, suffer the same pain. As HG Wells is credited with saying, 'When I see an adult riding a bicycle, I no longer despair for the



There is an extensive menu of rules and guidelines that makes cycling a more appetising sport for all involved

'As a professional cyclist, every time you're on your bike you're at work. Nobody wants to get hurt, so we have to really look after each other'

future of the human race.' That's the kind of thing that's worth a friendly wave of anybody's time, surely?

Etiquette in the professional peloton is a controversial subject, particularly in the light of the recent spate of high-profile crashes. The sport's rules are unambiguous and available in printed form, but the sport's etiquette is an unspoken, informal code (see our in-depth article on p106).

Vincenzo Nibali clearly broke the rules when he held on to his team car during the Vuelta, but it was a breach of etiquette when he accelerated away as Chris Froome suffered a mechanical during stage 19 of this year's Tour.

Some etiquette makes more sense than others. Will a rider ever challenge the convention that the final stage of the Tour must be a champagne-quaffing victory procession?

'There's a plethora of etiquette for different types of races,' says former British circuit race champion and Commonwealth Games track medallist James McCallum. 'A team captain's got to make sure none of his team are doing stupid things. Firstly, so they're not wasting energy; secondly, so they're not bringing the team's name down; and thirdly, so that they're not putting their sponsors in a bad light.'

Group riding etiquette came into question when a crash forced Dan Martin out of this year's Vuelta and he tweeted: 'Why so many crashes this year? My opinion: guys showing less professional respect/caution, fighting for every position, take more risks.'

McCallum agrees: 'There are younger riders coming in and maybe the respect level for the older riders isn't there as much.' McCallum, who took up the post of sporting director for One Pro Cycling at last month's Tour of Britain, agrees that etiquette in the peloton has to be taken seriously by everyone.

'As a professional cyclist, every time you're on your bike you're at work,' he says. 'Everyone has a mutual understanding that we all want to get through, we don't want to get hurt, so we have to really look after each other.'

But that attitude doesn't always trickle down to club or sportive riders. 'Newbies don't necessarily get the etiquette as they're coming into the sport from a different angle,' he says.

'I worked on British Cycling's Road Commission which assessed races and the reasons for crashes, and we made videos about bunch etiquette. The sport was a dark art, but it's so mainstream now there's lots and lots of information available. There's no excuse not to know how to behave in a bunch.'

Debrett's, which charges aristocrats a fortune to teach them how to fold a napkin, doesn't have a policy on politeness in the peloton, but does offer this more general observation: 'Good manners in sport are paramount, as in other aspects of life. Even if this means you lose again and again, at least you will be doing it gracefully.'

Are you reading, Vincenzo?



Pro cycling used to be a dark art. Nowadays, there's no excuse not to know how to behave when riding in a bunch



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PRIMAL

The power to choose

With a host of devices on the market to measure our power output, *Cyclist* examines how one power meter can offer very different things to another

Words **PETER STUART** Photography **HENRY CARTER**



Using a set of strain gauges to measure the power being pumped into a drivetrain was once the stuff of *Tomorrow's World*. Even when the technology came into production it was a luxury confined to only the top professionals. But now, not only are power meters affordable to most riders, there's a huge variety to choose from.

Making that choice can be tricky though, because one power meter can be ideal for one rider but less than perfect for another, and there are several reasons for this.

First, power can be measured from different parts of a bike. One obvious place for measuring it is at the crank. 'The crank is the place where power is being put into the bicycle, where torque is generated,' says Dr Auriel Forrester, the UK distributor of the original power meter brand, SRM, and a cycling coach (scientific-coaching.com). 'It's protected from damage, and we have space there for strain gauges and an internal battery.' No surprise, then, that the crankset is where most power meters are located, albeit in slightly different places: the spider, the crank arms and the axle, for example. But power also travels through several other parts of the bike, so it can be measured at the pedals, the chainring and the rear hub, each having advantages and disadvantages.

The crankset in itself is a pricey component, and with a power meter installed it can become prohibitively expensive for many. The SRM Campagnolo Super Record crankset (pictured overleaf) costs a penny short of £3,350 with the latest head unit. There are also practical problems with several crank-based systems, which often require a specific groupset. Rotor, for example, produces a power meter that works only with its own components. Crank-based systems can also require a lot of work to switch between bikes, and typically carry a weight penalty.

PowerTap's hub-based power meter was the first popular alternative to crank-based systems. 'You don't even need a tool to switch the PowerTap hub from one bike to another, plus it has easily replaceable batteries and communicates in ANT+ [neither of which the SRM offers],' says Justin Heinkel, PowerTap's product manager. But there are downsides. Not every brand produces PowerTap compatible wheels, and many people use different wheels for training and racing.

Pedals are another viable location for power meters, yet while these are transferable between bikes and easy to install, they restrict the very personal choice of pedal and cleat system.

However, price is the main factor that informs buying decisions, and thanks to the emergence of power meters that cost less than a mid-level wheel upgrade, their popularity has boomed.

Above:
Stages Shimano Dura-Ace 9000 power meter, £799, saddleback.co.uk

Overleaf, from top:
PowerTap GS power meter, £699, paligap.cc

SRM Campagnolo 11-Speed power meter, £3,349, scientific-coaching.com

Garmin Vector 2 Road Keo power meter, £1,199.99, madison.co.uk

Power to the people

In 2012, Stages launched a unit that weighed only 20g and cost as little as £600 that used an algorithm to estimate the power in both legs based on the output of only the left. Other manufacturers, including Garmin, Rotor and Pioneer, soon followed suit. Cycling coach and former national







champion Dave Lloyd sees this level of information as ample for most amateurs. 'For me, affordability is the main thing,' he says. 'A lot of my athletes have power meters because they're cheaper now. Not many of my athletes have £3,000 to spend on a training tool.' Lloyd, like many coaches, sees power output as a useful metric once an athlete has got to terms with heart rate training.

There is a but. Troy Hoskin, product manager at Quarq (Sram's spider-based power meter), says, 'Single-sided power meters are a good introduction to power, but there are inherent problems. All of the science, and the testing we've done ourselves, shows that cyclists commonly have 8-9% asymmetry, and that the asymmetry varies depending on your level of effort or fatigue.'

This is important because if an imbalance between legs changes, it could either mask or exaggerate a rider's fatigue. 'A single-sided option works well to give you better training feedback than you get from a heart rate monitor, or to reflect overall training load, but in terms of the precision you need for doing interval or threshold sessions, or even pacing a long race or time-trial, you should definitely be measuring both legs,' says Hoskin.

PowerTap doesn't offer products that only measure output on one side. 'I think they give a false sense of accuracy,' says Henkel. 'I've seen plenty of power files, and a simple imbalance of 3% becomes 6% when you're measuring from one side and doubling it. Now, 6% of 300 watts is nearly 20 watts, and if my power meter was off by 20 watts I'd be pretty upset.'

Unsurprisingly, Stages sees things differently. 'Our data doesn't support the argument that riders become significantly more imbalanced with fatigue,' says marketing manager Matt Pacocha. 'In riders we've found with slight imbalances, as they increase effort the balance comes together in a consistent manner.'

Measuring the total power output is very different to measuring the input from each leg individually, though. While most power meters measure overall power, only a handful can measure each leg independently and compare the two.

Left and right

The emergence of pedal-based power meters, which measure power output on each side using separate units, has addressed this for the first time. 'It could be that your left leg is pulling up more and allowing the right to produce a higher peak,' says Pacocha. 'In that case, your weaker leg could be reported as the stronger leg. That means pedalling drills to strengthen the left leg could actually make the problem worse. These combined systems [that measure only the total power through the crank] just aren't a viable balance measurement tool.'

The opportunity for right and left isolation may seem like a minor detail, but the balance between legs reveals a lot about pedalling form, and so elevates the power meter from being a mere recorder of output to offering a level of technical coaching.

'In terms of the precision you need for doing interval or threshold sessions, you should definitely be measuring both legs' output'

There are those who dispute the significance of the balance between legs. 'I've never met anybody who has a hugely problematic discrepancy,' says Lloyd. 'And there's not much you can do to correct it. You can try leg exercises and one-legged drills but I think that just confuses matters.'

That's not the end of the argument, though. 'I think the jury is still out on that,' counters Henkel. 'The power absorbed when you're dragging on the back stroke is definitely something you can improve.' He goes so far as to suggest that power meters will play a big part in the development of bike fitting. 'I think the fit business is going to benefit the most from the advanced metrics, as you can gauge pretty closely how somebody's pedalling changes as their position changes on the bike.'

As with most component choices, there is no simple answer. But as Henkel says, 'I don't think there's a perfect power meter out there – it's just whatever suits your situation best.'


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Time machine

Can something be a classic if it's never gone away? *Cyclist* meets the man behind the birth of an icon – the Colnago Master

Words **JORDAN GIBBONS** Photography **JENNI LESKINEN**

For those who love a blend of traditional and modern, artisan steel bikes are seeing a resurgence, but there is one steel frame that can't be included in that category because it's never gone away. The Colnago Master has been on sale in various guises for over 30 years, and it remains recognisable by its distinctive clover leaf-shaped tubing.

Until the early 1980s all Colnago frames had regular round tubing, but after various complaints that these lacked stiffness, Ernesto Colnago, the company's founder, began to experiment with different tube shapes.

'The tubes started as a round shape. I was at a trade show in New York about 31 years ago and one night I couldn't sleep,' he tells *Cyclist*. 'I was staying at the Waldorf Astoria, and I looked up and I saw this design in the hotel [Colnago draws the tube shape for us] so I took some paper and drew it out.

'I thought this made more sense than using a round tube for tough frames – the design is the same now on the C60.'

If you see one of the first generation of Masters, the tubing is crimped, but the finish isn't nearly as refined as it is now.

'Making the first Master was a nervous moment,' Colnago says. 'We took the same tubes we were using for the Mexico and crimped them, but I realised that when we did this, the internal diameter was smaller. For the next Master we made the tubes bigger because if a tube has a 28mm diameter externally, it will end up with an internal diameter of 24mm after being crimped.'

The Master hasn't stayed still for those 30 years. The second edition of the bike had much smaller flats in the crimped areas to increase the internal diameter again and improve the frame stiffness. The current frame is made from DT15V steel, whereas the early ones were made from Columbus – but Angelo Columbus wanted nothing to do with it. The story goes that Angelo didn't want the integrity of his round tube shapes compromised.

'It was actually Gilberto, Angelo's brother, who made the tubes for us. It was originally called the Gilco, named after him, but in the end we called the tubing Gil/Co – Gilberto & Colnago.'

In 1987, Colnago produced the Precisa straight-bladed steel fork to go with the Master, renaming it the Master Light. Then after the demise of Colnago's Tecnos bike, the Master Extra-Light was introduced as we know it now. It ceased production in 2005, but returned due to demand in 2006.

The only real question for anyone considering buying one is – which finish? Art-Decor blue or Saronni red?













Colnago Master X-Light, £1,799 (frame, fork & headset), windwave.co.uk



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In the 1660s, JJ Becher theorised that combustible substances were full of 'phlogiston' and would 'dephlogisticate' when burned. Who knows what JJ would have made of this – a 600-lumen lamp little bigger than a matchbox? He'd probably have blamed witchcraft and burned Lezyne at the stake.

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4 ABBEY BIKE TOOLS BB SOCKET DUAL SIDED

£49.99, cycleworx.co.uk

Contrary to popular belief, Benedictine monk Dom Pérignon didn't invent champagne, but rather refined its fermentation process so the bottles wouldn't explode. Similarly, Abbey Bike Tools didn't invent bottom bracket removers, but did refine the design into a dual-sided tool that fits Shimano 105, Ultegra and Dura-Ace BBs with absolute precision.

5 CHAPEAU WINTER GLOVES

£39.99, chapeau.cc

Barbers. You've got to take your hat off to them. And one should also doff one's *chapeau* to these gloves, which have soft linings, Pittards leather palms and reflective outer fingers. *Très jolie.*



Dromarti.com



To ride or not to ride?

That is the question pondered by Frank Strack, the bard of the Velominati

Dear Frank
I didn't feel like riding my bike this weekend. Is there something wrong with me?
Steve, by email

Dear Steve
Yes. But I'm going to need a lot more context to tell you precisely what's wrong with you. You might not be Dutch, so that's a start. You could try being more Dutch. Also, are you getting enough vitamin D? If you live in a rainy place like England or Seattle, where I live, you might need to take supplements or travel to Hawaii to get your mind right.

I would concede that as much as I love Cycling, I find myself not wanting to ride a bike quite frequently. Our lives are busy, and the pull from familial and social life weighs constantly on our priorities to keep from riding. Cycling is hard, after all, and not riding is easy.

Whether I'm riding before or after work, the daily pressure of my profession weighs heavily. Riding early means putting off checking emails and returning calls while I slip into the early morning light. These rides come at the price of dredging myself from a warm bed in the early morning hours, when the sun is but creeping above the treetops to bathe the streets in a chilly pale light.

Riding in the afternoon means kitting up after arriving home, postponing the precious little time I have to spend with my family. Work, as well as the trials of daily life, draws its pound of flesh from us, distorting the energy we require to ride. I find the daily trials will have an unpredictable effect on my riding – sometimes a hard day at the office will have me raring for a good fight on the bike, yearning to kick my own head in and burn off unheeded aggression. Other days, I resent the notion of suffering on the bike and look on it as a means for a relaxing spin.

I am a better man when I ride my bicycle. I understand the balance of life more fully and leave many of the troubles and stresses of my life behind me when I come home from a ride. It's often hard to remember these things in those moments when it feels so much easier to stay home curled up in bed or enjoying the comforts of my family. But normally as soon as I am out there with the wind in my face and feel the rhythm of the pedals, I am glad that I'm out and wonder at how I resisted this beautiful experience.

But not always. Sometimes the rhythm doesn't seduce me, or the heaviness in my legs doesn't go away. Sometimes this feeling persists for a day or two, sometimes longer.

This can be for a number of reasons, from overtraining to burnout to simply being in a rut. Overtraining is the only one among those that is of concern. Training is designed to break the muscles down and, by giving them rest, rebuild them to get stronger over time. Overtraining means you're not giving the muscles the rest needed to recover and grow so they actually get weaker over time. Training isn't about riding every day until your eyeballs pop out – it's about structure and discipline, and sometimes sticking to your training plan and taking it easy, even when the guns feel ready to fire.

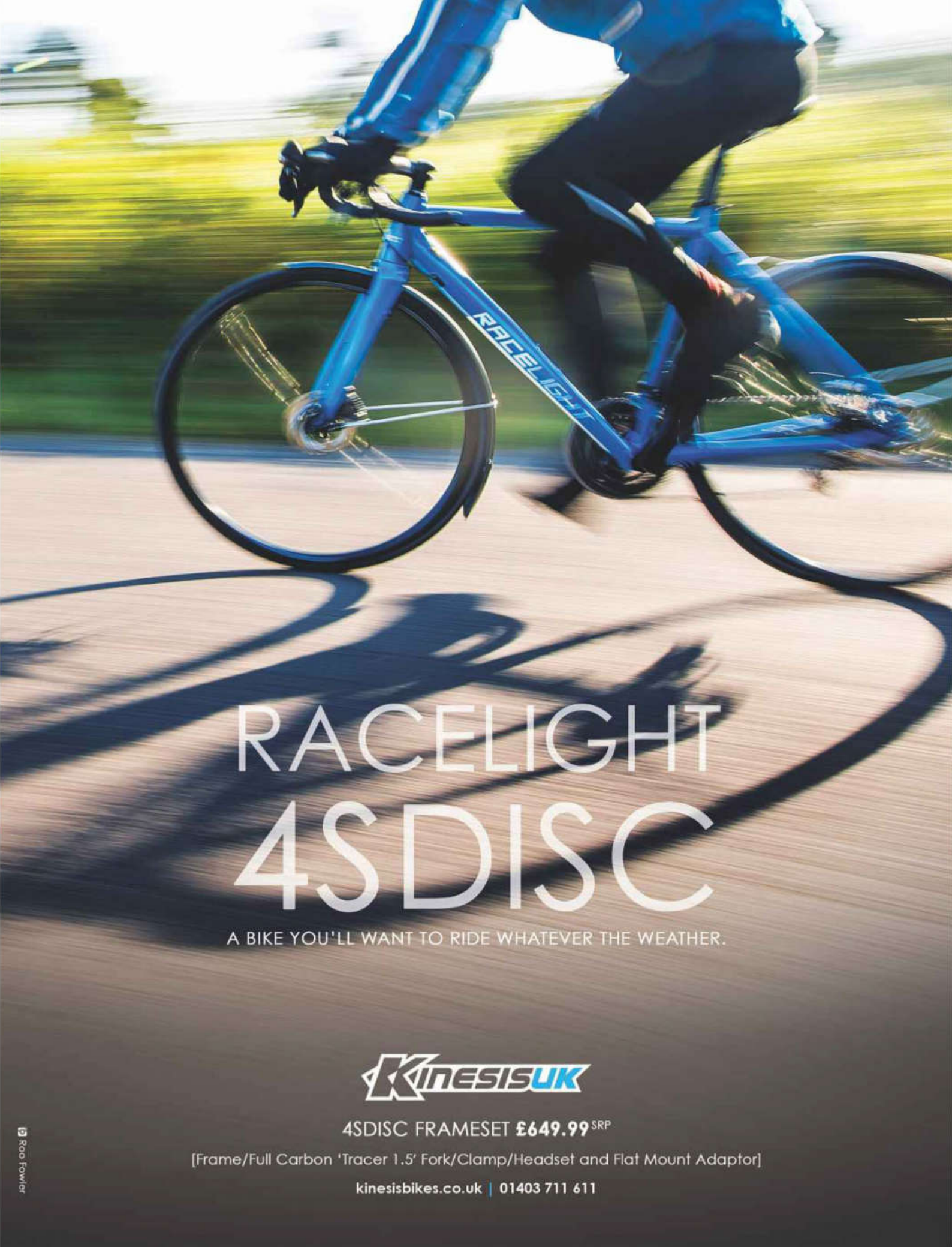
But burning out or being in a rut is much less serious and quite easy to remedy. I could point you to Rule #5 again, just to remind you to stop faffing about and go ride your bike already. Or, you could try a new route, ride with some different mates, or take to the dirt for a bit – I often find that riding off-road, far from civilisation, rekindles my spirit in ways that riding on the road rarely does.

I'm not getting paid to ride my bike, and I'm assuming you aren't either. Which means that Cycling is something we do for its inherent enjoyment, if also for the betterment of ourselves as people. But it comes at a price: we must always sacrifice something to enjoy that small bit of enlightenment that comes as part of being a Cyclist, we must always pull ourselves from the comforts of our home and family and submit to the bicycle and its binary world of beauty and suffering.



Frank Strack is the creator and curator of The Rules. For further illumination see velominati.com or find a copy of *The Rules* (Sceptre) in all good bookshops. Email your questions to him at cyclist@dennis.co.uk

Illustration **Clear as Mud**



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The Austrian Alternative

When *Cyclist* finds itself thwarted by roadworks, the door opens for an impromptu epic in the Austrian Tyrol

Words **HENRY CATCHPOLE** Photography **RICHIE HOPSON**



Organising a Big Ride is a complex business. Weeks are spent poring over maps and photos to choose the best routes. Then we need to arrange flights, transfers, accommodation, bikes, a photographer, a car for the photographer, a driver for the car for the photographer... There's a lot to consider, which is why we often call on local riders to help with routes, offer advice and join us on the ride.

I'm halfway through a pizza in a restaurant in Austria when I bring up the subject of which keen locals I'm going to be riding with the next day. Ernst, our guide, who has kindly offered to host *Cyclist* in his homeland, looks at me with an expression of surprise.

'Tomorrow?' he says. 'No one will be riding tomorrow. There have been nine weeks of sunshine and tomorrow it will be raining.'

He goes back to doing battle with his Diavola, oblivious to my spirits deflating like a punctured inner tube. I'm left contemplating the prospect of a soggy solo ride. At least I'll only have to keep up with myself, although I'm pretty sure I won't really be the only person out pedalling on a Sunday in summer in the beautiful Austrian Tyrol.

A few minutes later, after ordering another couple of restorative *weissbier*, I bring up the subject of the route we're going to tackle.

'I thought we'd focus our photos on the Silvretta Pass tomorrow as I know you said the Arlberg is rather busy at the moment,' I say.



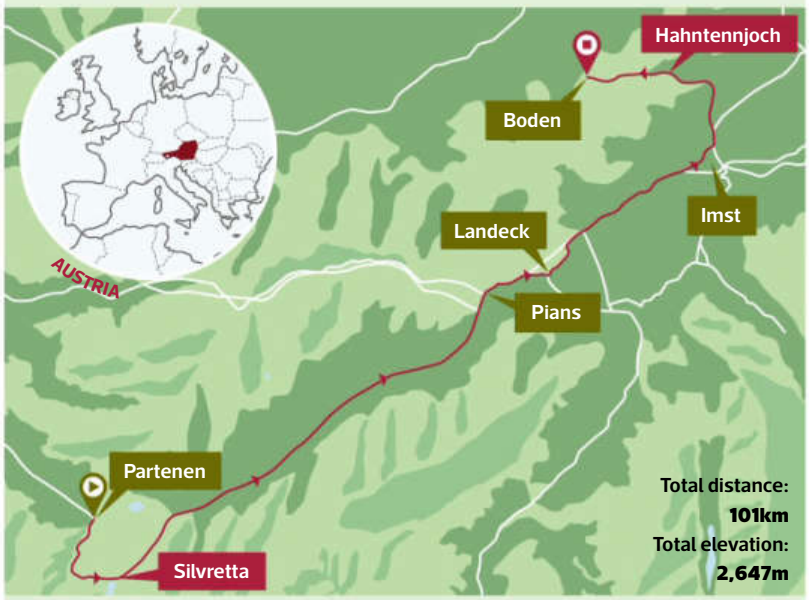
An abundance of hairpins on the Silvretta Pass help to break up the steep early stages of the climb



The hills are alive...

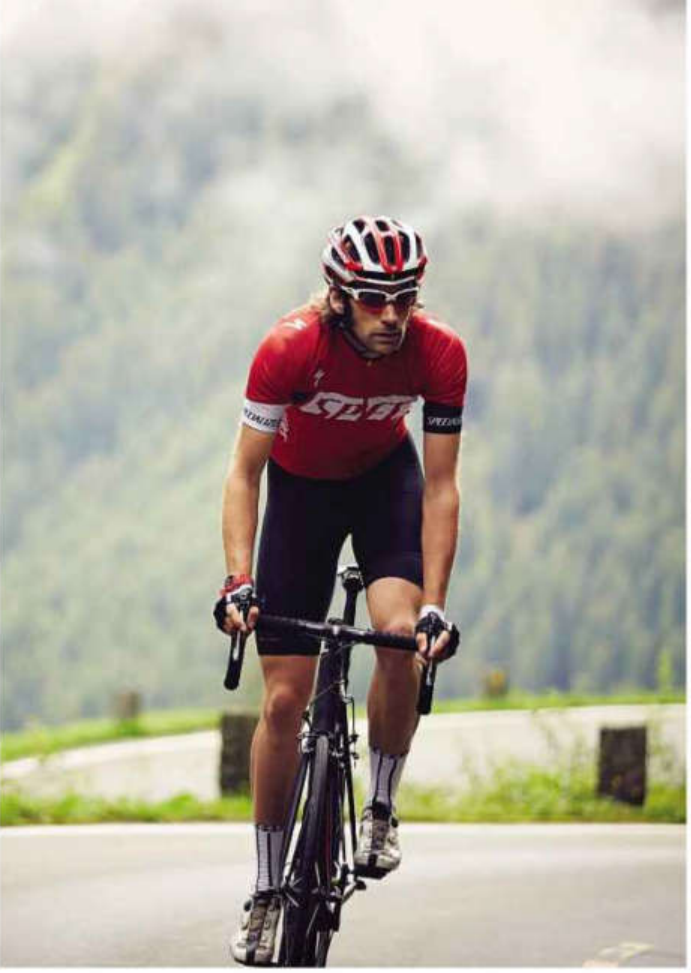
...with the sound of wheezing

Beginning in Partenen, follow the Silvretta Hochalpenstrasse (the B188) east. Continue over the summit and on down to Pians where you pick up the B171 towards Landeck. The B171 will lead you to Imst where you can either head through the town or briefly pick up the B189 until you see the sign for the Hahntennjoch off to the left. Travel about 300m down Thomas Walch Strasse before turning right onto the Hahntennjoch, which you then simply follow all the way to Boden or even on to Elmen.





'Tomorrow?' he says. 'No one will be riding tomorrow. There have been nine weeks of sunshine and tomorrow it will be raining'





‘Yes, the big Arlberg tunnel is closed for maintenance, so all the traffic has to go over the pass,’ confirms Ernst. ‘It’s shut to cyclists though.’

I stop chewing and glance at Richie, the photographer.

‘Shut?’ says Richie, trying desperately to keep the panic out of his voice. ‘I thought it was just going to be busy…’

‘Oh no, it’s shut,’ says Ernst, gaily ripping out our spiritual valves as the final 20psi escapes from our already limp morale.

It’s a sombre if not entirely sober rest of the meal, but while Richie and Ernst chat about cameras, I head back to my hotel room to set to work with a laptop and Google Maps. By the time I switch the light out and go to sleep I have a plan…

Into the clouds

The following morning we stop at the small black booths marking the toll barriers. This is the western end of the Silvretta Pass, which marks the start of my ride, and the good news is that it isn’t raining. The pristine tarmac glistens with a film of water and the air is cool with moisture but there isn’t actually any precipitation.

The small settlement of Partenen lies just below us in the valley and there is a stillness to the mountains as I pull on a thin gilet for the beginning of the ride, although looking at the steepness of the slopes above me I’m pretty sure I’ll be warm enough to remove it again fairly soon. The Silvretta has a whopping 34 hairpins in its 22.3km length, helping keep the gradient down to an average of 6.9%. That doesn’t sound too bad, but it’s the first half that is the real test, with the opening 6km averaging 9.3%.

The first few hairpins slide by as I make my way up through the pines, gradually settling into a rhythm. Despite the gradient it’s actually a lovely road to climb.





The Silvretta has a whopping 34 hairpins in its 22.3km length, and it's the first half that is the real test, with the opening 6km averaging 9.3%

Hairpins not only look dramatic, they are very much the cyclist's friend, in my opinion. A minute or two of effort, feeling the lactic slowly build, and then a few seconds of physical respite as you're released from the tussle with gravity, the muscles relaxing slightly as the road loops back on itself. Sometimes of course you're forced to take the tight line and then there isn't much of a slackening for taut leg muscles, yet still the switchback is a benefit because it is a break for the mind. Hairpins give you constant little goals to achieve, chopping up the pain into bite size chunks that make it seem just a bit more manageable, distracting from the magnitude of the overall task. Even the fact that they constantly change the view is welcome.

It's quite a view too, with the contorted strip of road twisting back down the lush green slope below, but a quick look above me shows that the view is about to disappear. Over the next kilometre I cycle into an ever-thickening white miasma as the cloud envelops me, cloaking me from my surroundings so that all I can see are the now ghostly trees nearest the road's edge. Somehow this slightly spooky setting exaggerates my solitude. The occasional car materialises behind me before overtaking and then being

The rain holds off – for now – but the Silvretta is shrouded in a ghostly mist that makes the silence even louder

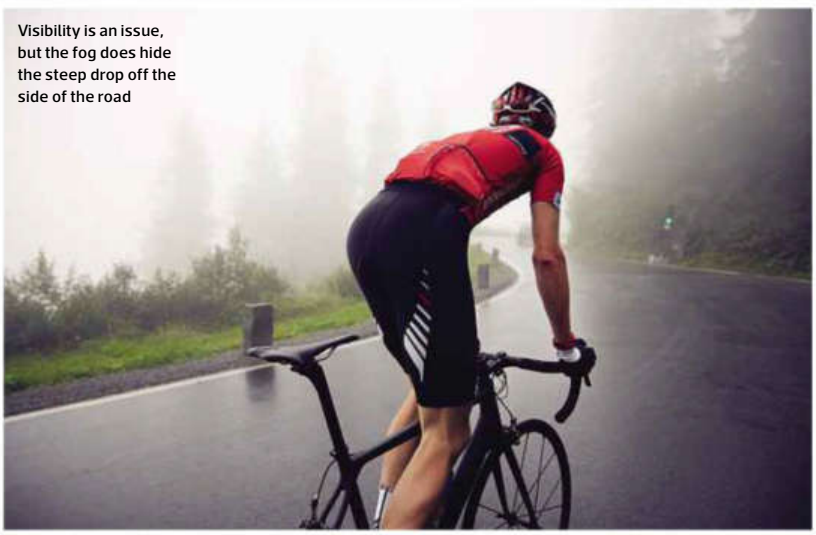
The occasional car materialises before being consumed by the cloud ahead

consumed by the cloud ahead once more, but otherwise it's just me, the bike and a bit of suffering.

Over the Silvretta

As I climb ever higher, the temperature is cool but actually rather pleasant and I've long since banished my ghostly white gilet to my back pocket. The gradient eventually eases a little, and then a little more, until I realise I can actually put it into the big ring for a short while. Settling down onto the drops as my pace increases, the cool air whips round my arms disturbing the tiny beads of water clinging to the hairs. Passing a construction site the road is covered in a light beige-coloured mud, which splatters the chainstays and seatpost as though I've been riding through Belgium in spring rather than Austria in summer.

It seems as though the sticky mud is slowing the bike down too, but in fact the gradient has just begun kicking up again. It's not quite as severe, but I'm soon back in



Visibility is an issue, but the fog does hide the steep drop off the side of the road



The rider's ride

Canyon Ultimate CF SLX 9.0 LTD EPS (2014), £5,599, canyon.com

Going uphill you couldn't wish for a better companion. The frame weighs a claimed 790g and the whole bike tips the scales at a smidge over 6kg, so as you can imagine at times it barely feels like it's there at all. With a compact groupset, this is one bike that's born for the mountains.

Over rougher sections of tarmac the bike remained comfortable, as you would expect given the size zero seatstays and the 27.2mm seatpost, although the stiff Mavic R-Sys SLR wheels could jar at times. This isn't a sprinter's bike (you can feel the flex if you stamp down hard enough), but downhill and on the flat the Ultimate handled beautifully. The Exalith braking surface on the wheels is noisy (a high-pitched buzz is not something you want shattering the peace of the mountains) but effective. The only thing I would change would be the Mavic Yksion Pro SSC tyres, which didn't inspire confidence in the wet.





DOUBLE REIGN-BOW

Congratulations to Peter Sagan and Lizzie Armitstead on their masterful performances at the World Championships in Richmond. The Rainbow Jersey suits you both. specialized.com



The Silvretta seems to be Chimera-like, created with the hind of Alpe d'Huez, the body of the Lago di Sauris and the head of somewhere in the Lake District

the little ring. The trees have disappeared and if I could see them the mountain peaks would be gathering around me. The highest is the Piz Linard (3,411m), although the best known is probably the Piz Buin. Certainly no need for sun cream today, although as I reach the summit there are still a remarkable number of people around. On my right I can just catch glimpses of turquoise glacier-fed water. This is the Silvretta-Stausse, the second of two big reservoirs (I never even saw the first one, although I think it must have been just after the mud). I stop briefly at the 2,034m summit and although I'm not cold or tired enough to drop into the cafe I spend a moment just looking at the scene. It's weirdly apocalyptic, with cloud drifting like smoke across the landscape and zombie-like people wandering aimlessly. Perhaps the climb was harder than I thought.

As soon as I begin descending something curious happens. I'm no meteorologist so my best guess is that it probably involves thermal currents, but the cloud, which had been thick down to a much lower altitude on the other side of the pass, disappears, revealing a beautiful green valley with just two or three mellow hairpins near the start before the road unwinds into a long grey thread. The Silvretta seems to be Chimera-like, created with the hind of Alpe d'Huez, the body of the Lago di Sauris



and the head of somewhere in the Lake District, perhaps the lower stretches of the Honister.

Now picturing myself as mythical hero Bellerophon on a bike with the Canyon my Pegasus, I set off with renewed vigour. I fly through the first hairpin, revelling in dry asphalt and the most fabulously positive camber. As I fire out of the far side the only thing disturbing the peace is a rumble of Harley Davidsons (I'm not sure of the correct collective noun, but rumble seems about right) making its way up the pass towards me. I cover a good half-kilometre before we finally cross paths, slicing through an open hairpin that tightens a little just before the exit, requiring either extreme foresight and patience or a nerve-wracking squeeze on the rear brake with the bike already leaning.

From there on there's no need to touch the brakes for kilometre after blissful kilometre. The bends are shallow and the drop is gradual, wringing the absolute maximum descending pleasure from all of the altitude gained during the climb. If ever there was a place to practise your best Peter Sagan descending skills this is it, as you can see so far ahead that you can adopt the squashed frog position without fear that you're suddenly going to have to leap back into the saddle to haul on the brakes. There are even a few short stretches of flat where it seems only right to sprint to keep the speed up. With gravity substituting for Renshaw as a lead out, it's exhilarating to rock the bike from side to side and feel what a top speed sprint feels like.

I'm really enjoying this side of the Silvretta. Not only is it beautiful, in this direction the cycling is flattering in the extreme. There are some curious small lakes with fisherman standing in them, then I'm through the black toll booths marking the eastern side of the pass. But that isn't the end of the fun. If I was driving a car the entertainment of the descent would have ended at



Left: The bits of the route that don't go uphill are a great opportunity to ride fast, with hardly any traffic and no other cyclists around





the booths, and the scenery isn't quite so worthy of a postcard, but the cycling is still top drawer. The gradient continues to encourage just enough effort that your legs feel like they're on a good day, regardless of current form.

The first time I touch the brakes is just before sweeping through the large village of Galtur but there's barely any speed lost as I pop out of the other side. Tschafein, Valzur, Mathon, Ischgl… the smattering of settlements come and go in a flash. As so often is the case in a valley, we're following a road that takes the line of least resistance, just like water running nearby. The river eventually makes itself more obvious, growing in size as it joins forces with tributaries near the head of the valley. There is also one of those castles that are sprinkled throughout Europe, which perches on a seemingly totally inaccessible pinnacle of rock.

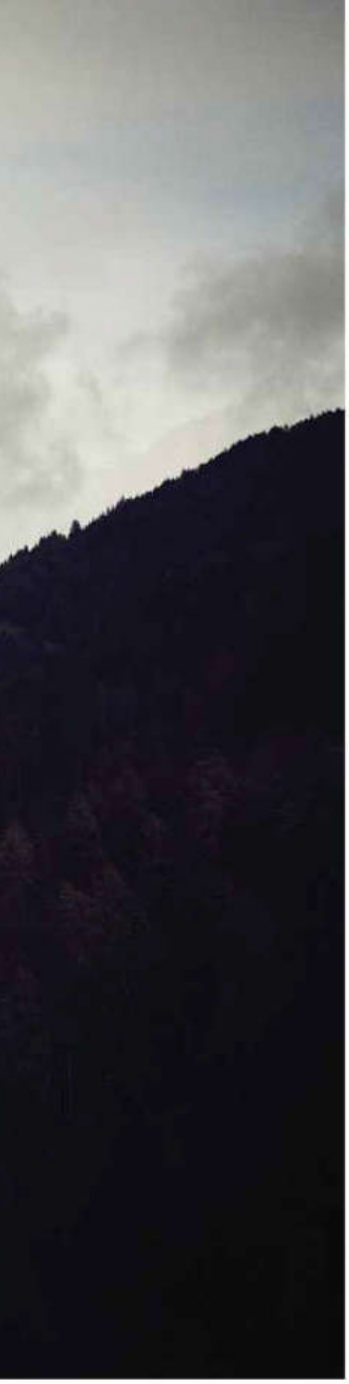
The new plan

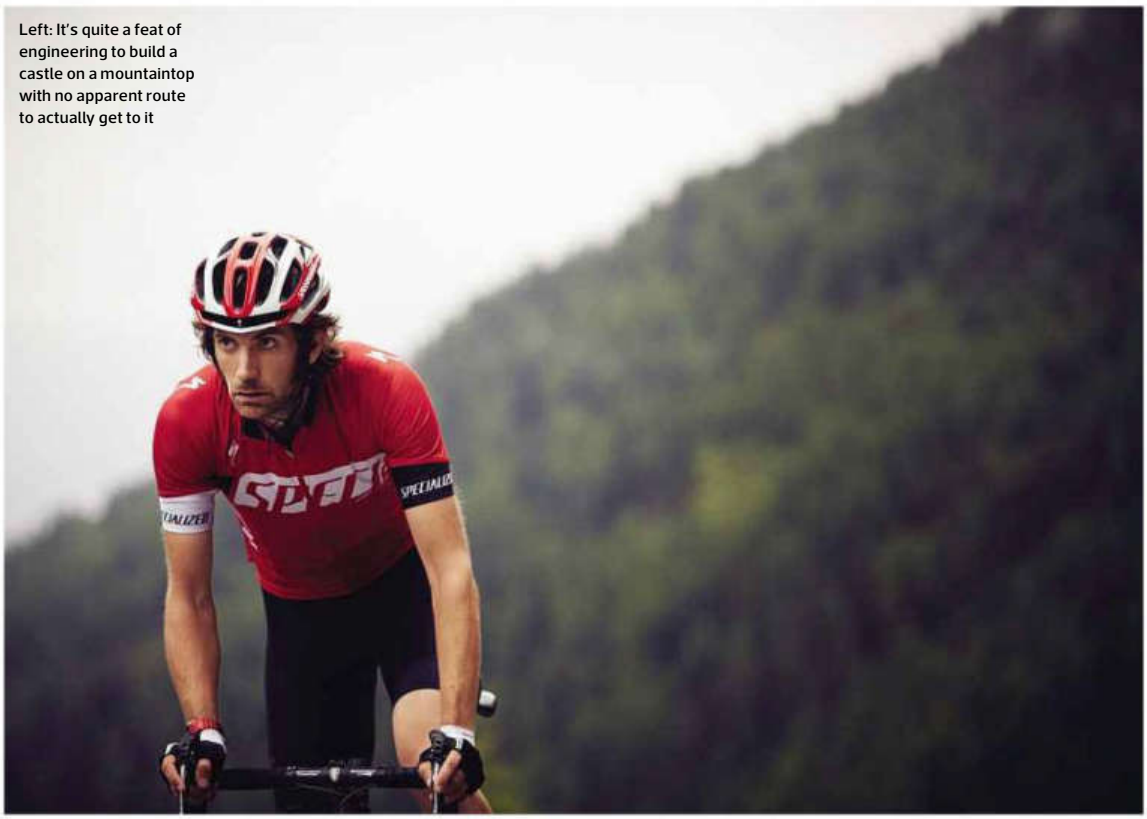
Talking of inaccessible, this is the point where the original plan was to turn left towards the Arlberg. The roadworks are scheduled to be finished by the time you read this, but the likelihood is that snow and furry hats will have taken up residence as the road leads up to the ski resort of St Anton. Nonetheless if you're planning to do this ride next year, the Arlberg is your route back to the start of the Silvretta.

Right now, the Arlberg isn't an option, so I continue up through Landeck and the exciting-sounding Zams until I arrive at Imst. Just as I'm about to roll out of town I spy a gaggle of car dealerships on the left and a sign pointing to my new objective for the day: the Hahntennjoch Pass.

Things start painfully. I make my way past chalets with flower boxes filled to bursting with vibrant blooms when the road begins ramping up. Turning a shallow bend I'm confronted by a short, straight climb that looks like something out of an Ardennes classic. I'm not sure what the percentage is, but judging by the way the houses are stepped steeply down it must be well into double figures. There really is nothing for it but to get out of the saddle, pump with the arms as well as the legs and scale it as best I can while hoping that I'm not putting myself too much into the red given that there's still another 14km to go.







Left: It's quite a feat of engineering to build a castle on a mountaintop with no apparent route to actually get to it

I watch my leg motion for a bit. I try to decide whether I prefer EPS or Di2. I think about which pizza topping I'm going to have. Then the mountain butts in



Thankfully the gradient begins to ease as the houses recede and after a couple of hairpins I'm out among pine trees and back on the saddle, spinning much more easily. In fact the next little stretch is really rather pleasant. The road is still climbing but only just, and the fresh smell from the pine trees is invigorating. Although the sun hasn't actually put in an appearance yet, the weather is still perfectly pleasant and I cycle along rather enjoying my solitude. Cycling with others is always nice, but equally the ability to pedal through a mountain forest just thinking your own thoughts seems like a rare treat in a busy and crowded world. I watch my leg motion for a bit, trying to remember to ankle a little more. I try to decide whether I prefer EPS or Di2. I think about which pizza topping I'm going to have this evening. Then the mountain butts in.

Almost imperceptibly the road has been increasing the incline, subtly spooning on the pain until now I discover I have run out of gears. I can feel the pads in my helmet (which you will have noticed matches the carefully coordinated Austrian colour theme of the rest of my

By the numbers

Every stat tells a story

0
Other cyclists seen

18
Maximum gradient in per cent on the Hahntennjoch

75
Maximum speed in kmh

101
Distance ridden in km

147
Distance of the original route in km

1
Castle in the sky



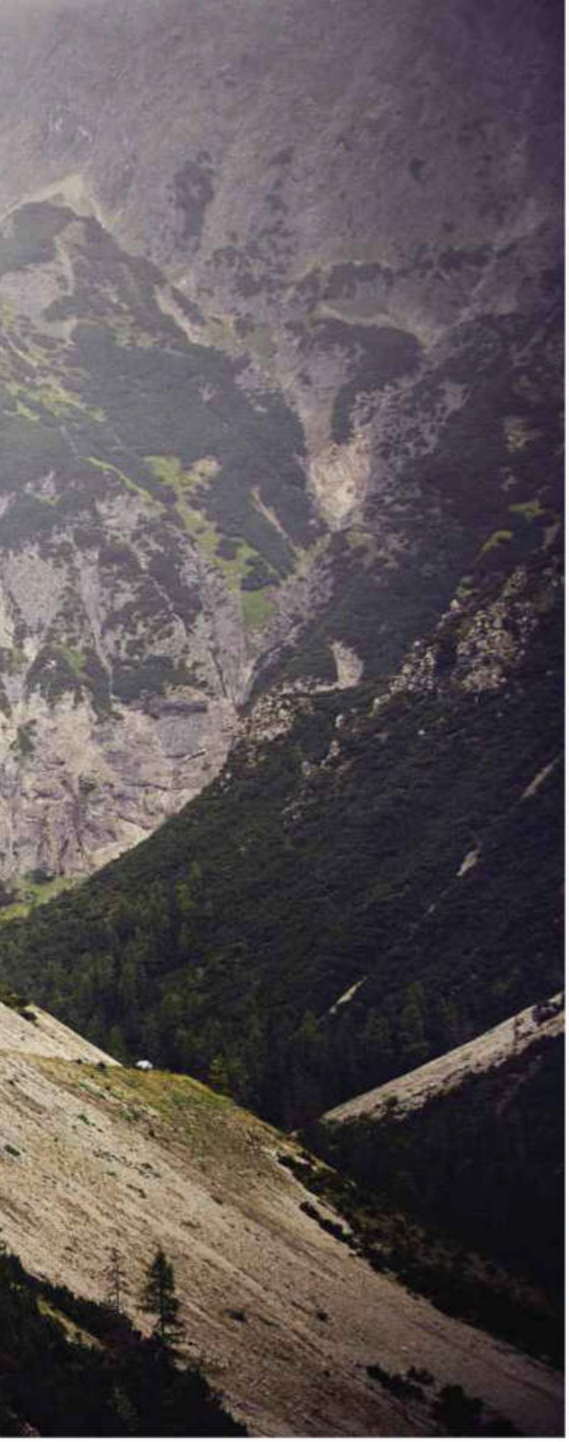
kit) are saturated with sweat and I'm now working hard trying to keep my core strong, isolate the legs and keep them spinning rather than grinding. The trees have been retreating and a big rock wall has sprung up on my left while to my right I'm looking across a deep chasm. The sensation is very different to the friendly Silvretta. Not only is the drop intimidating and getting more so by the metre, the range of dark peaks across the narrow valley is enormous, the serrated ridgeline looming menacingly.

The landscape seems to be a natural fortress designed to repel all who wish to enter, and the road is no more inviting. There isn't a hairpin in sight and 7km into the climb the gradient is reaching back well into double figures once more. It is hurting.

Following the pros

I can't say I recognise the name Denifl but it's clear he's popular as his name is daubed in white paint at various intervals up the climb. It turns out that Stefan Denifl is an Austrian who rides for WorldTour team IAM Cycling. He was in fact the highest placed Austrian in the 2015 Tour of Austria, which came over the Hahntennjoch on its ninth and final stage. If you're wondering how you missed the Tour of Austria, it's probably because you were too busy watching the Tour de France. It's a shame really because the Austrian race must be one of the most picturesque tours on the calendar and all that was happening in Le Tour that day was a team time-trial.

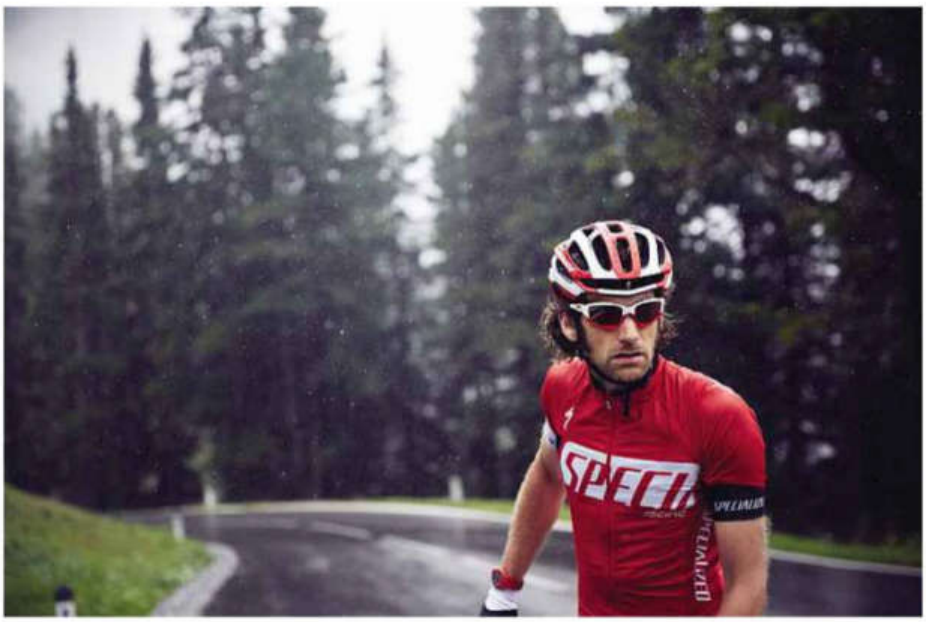
The summit finally arrives, the road flattening and my heart rate mercifully dropping as I spin my legs out and then press the lever behind the left hand brake to whirr the chain back up into the big ring. At the same time as things ease and I have a chance to look around the backdrop changes too. Quite abruptly the steep rockface to my left is replaced with a huge bare scree slope the colour of light taupe. It's like a vast mountainous sand



dune, and I suddenly remember that someone once told me the Hahntennjoch is infamous for its landslides. A peek over the edge confirms that the road somehow runs right through the middle of all the scree and I can suddenly feel my heart rate climbing again even though the road isn't. Yet.

Around the corner it's clear that this was a false summit. In fact another 2km with the gradient at nearly 10% still has to be covered, and it has just started raining. The consolation is that my legs seem to like the rain, the cooling water doing my quads the power of good. I can't say I exactly fly up the last stretch but I reckon I make a decent fist of it. The summit proper greets me with a wet cattle grid to ride slowly over (always a mildly terrifying experience) and with the rain getting harder by the second I don't pause even for a moment, instead pushing straight on for the descent towards Boden.

The steep and imposing Hahntennjoch Pass nestles in far less friendly scenery than the Silvretta





It's like a vast mountainous sand dune, and I remember the Hahntennjoch is infamous for its landslides



Moments later I'm in whole world of trouble. The final 5km on this side of the mountain is even steeper, and plummeting down on a road that resembles a river is petrifying. The tyres just don't seem to be coping with the standing water and trying to brake hard as gravity plunges me towards a sharp left hand turn takes every ounce of terrified finesse I can muster from my cold fingers.

In his short film *Road Bike Party 2*, Martyn Ashton manages to cycle down a water slide, and this feels rather like that must have done, but without the nice upswept sides. Somehow, with the bike squirming around, I make it through the bend, but I have a much closer look at the drop off the edge than I'd have liked. I continue on, trying to keep everything at a slower pace, but despite it being the lightest bike I've ever ridden the Canyon now feels like a runaway boulder. I can honestly say it's the first time I've ever wished for disc brakes.

When I find photographer Richie parked up at the side of the road a few kilometres later I don't think twice about stopping and getting into some warm dry clothes. It's bliss. I know that the gradient will ease after Boden and on a warm summer's day there would be nothing nicer than descending the rest of the Hahntennjoch. But not today. It's been fun, but perhaps there is a reason I haven't seen a single other cyclist...

Henry Catchpole is a cycling and motoring journalist who knows which mode of transport he prefers when the rain starts falling

Somehow I make it through the bend, but I have a much closer look at the drop off the edge than I'd have liked

How we got there

TRAVEL
Innsbruck is the best-located airport to fly into, though there are no direct flights from the UK. Plenty of UK airports fly to Salzburg direct, from where it's a four-hour drive. Another option is to fly to Munich (or Zurich), hire a car and drive the two-and-a-half hours to the Silvretta. You could stop at the Hahntennjoch on the way, then carry on and do our planned loop via the Arlberg.

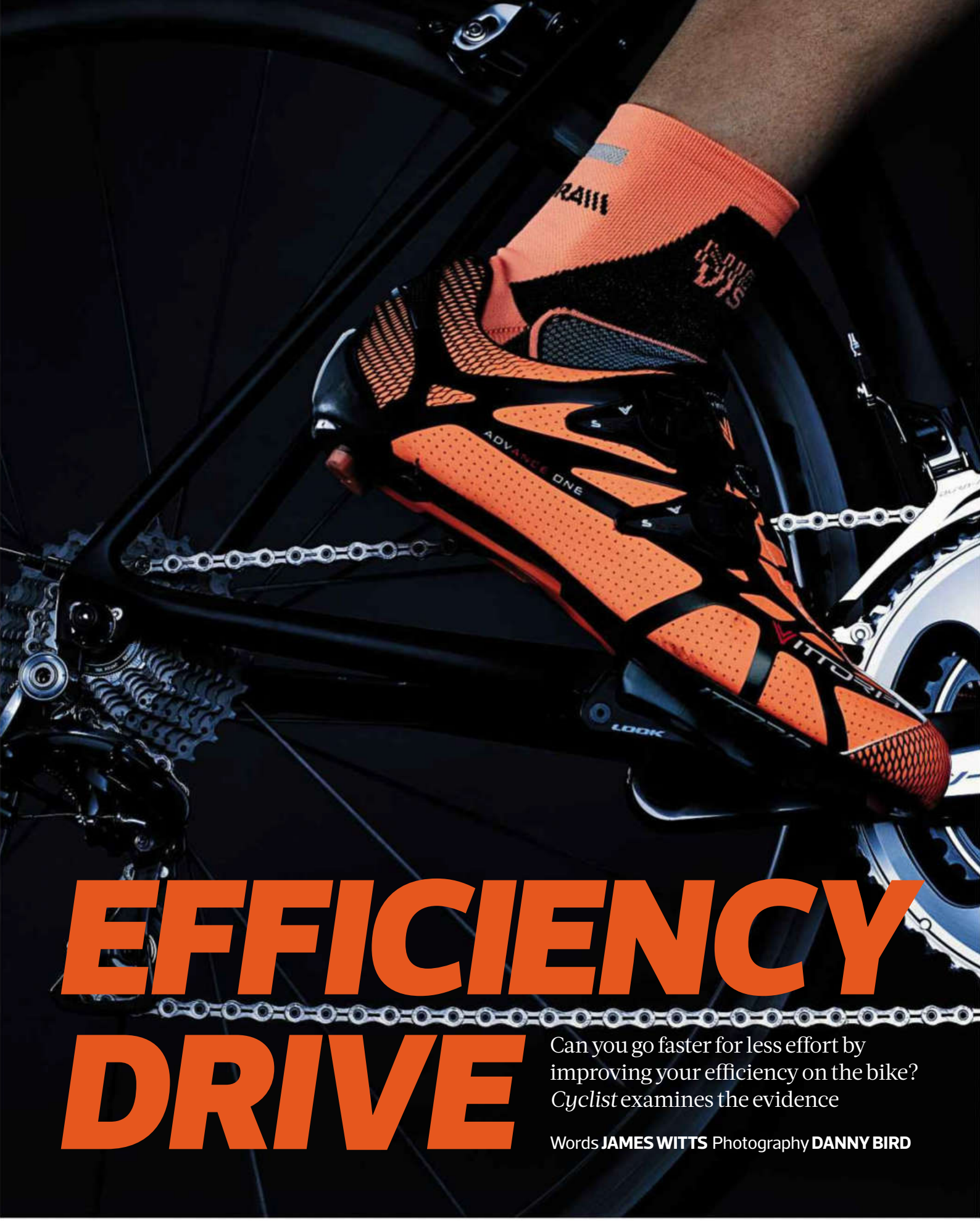
ACCOMMODATION
Cyclist stayed in the town of Sölden, a couple of hours from the start point in Partenen, however closer accommodation can be found by going to the website at montafon.at/en.

THANKS
Many thanks to Ernst Lorenzi, who helped with logisitics and accommodation. Ernst is organiser of the Ötztaler Radmarathon sportive, which takes place in the Austrian Tyrol in late August (oetztaler-radmarathon.com). Read our story from this event when *Cyclist* issue 44 hits shelves in early January.



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EFFICIENCY DRIVE

Can you go faster for less effort by improving your efficiency on the bike? *Cyclist* examines the evidence

Words **JAMES WITTS** Photography **DANNY BIRD**



Cyclists love pain. It's worn as a badge of honour, because the more you hurt, the faster you go, leaving those weaker in mind and body in your wake. Except, when you watch the pros, they often seem to be expending very little effort at all, yet they cruise along at speeds that would leave most weekend riders gasping for breath. Is it simply that the pros have bigger engines?

'Interestingly, there's an inverse relationship between maximal oxygen uptake [VO_2 max] and cycling efficiency observed in top professional cyclists,' says BMC Racing sports scientist David Bailey, who works with riders of the calibre of Tejay van Garderen. 'This means cyclists with the highest VO_2 max are less efficient than those with a lower VO_2 max. This is one reason why the Twitterati (or scientific community, depending on your position) have repeatedly asked for Froome's VO_2 max scores. With that they can better estimate efficiency and subsequently the "validity" of climbing performances.'

So what exactly is the Holy Grail that is efficiency? Cycling efficiency is defined as the ratio of work done (power output) to total energy expended (kilojoules). This can be measured in percentage terms by dividing 'energy out' by 'energy in' and multiplying that figure by 100.

'Work done is easily measured with commercially available power meters, and energy expenditure can be indirectly assessed by measuring oxygen cost [VO_2],' says Bailey. 'This figure can range between 18 and 23% [Lance Armstrong reportedly came in at 23%]. This may appear inefficient but up to 90% of energy is lost as heat during normal metabolic processes.'

A rider's efficiency comes down to a mix of many factors including muscle genotype, fitness level, biomechanical efficiency, nutrition and age. That's why VO_2 max is too simplistic a determinant of endurance performance. But how can a rider improve their efficiency? The answer is so long it could roll into 2016. So first let's focus on the key determinants of efficiency, beginning with biomechanics...

Pedal technique

The way you turn the pedals on your bike may have changed little since the day your dad released his grip and you wobbled off without stabilisers for the first time. From that moment, your improvements as a cyclist have probably come from getting stronger and fitter, but even the subtlest of changes in biomechanics can increase efficiency and reduce the risk of injury.

'It's key that you push from the one o'clock position right through to the seven o'clock position,' says Dr Auriel Forrester, coach and UK distributor for SRM power meters. 'This engages

the big muscles such as the quadriceps. To achieve this you must have the correct riding position to start with. I recommend being seated such that the centre of your knee joint is over the pedal spindle when the crank is at 3 o'clock. This is important because that's where much of your power derives from. If you sit too far back you'll stop being as productive at the five o'clock position and end up doing too much work with smaller, weaker muscles to bring the pedal back.'

Another factor in efficient pedalling is the degree of ankle movement through the 360° rotation – known as ankling. Tradition suggests the ankle should remain neutral, although Armstrong was a noted toes-down (plantarflexion) cyclist in contrast to former Time-Trial World Champion Santiago Botero, who would lead with his heels down (dorsiflexion).

A study conducted at San Diego University by professor Daniel Cannon compared the effects of 7° of dorsiflexion or plantarflexion on 11 fit recreational cyclists. The results suggested that dorsiflexion is significantly less efficient than neutral and plantarflexion with more oxygen required to generate the same power output.

year's Tour. Head of performance Tim Kerrison analysed the last 15.3km of the stage, covering the entire climb to La Pierre-Saint-Martin.

Among the data, which revealed a power-to-weight ratio of 5.78 watts per kilogram, Froome's average cadence for his 41min 28sec ascent was reported as 97rpm. During the 24-second attack that blew his rivals apart that figure rose to 120rpm. Clearly this proved optimum for Froome but would this 100-plus cadence be appropriate for all?

Not according to an Italian study that measured the cadence of seven pro cyclists during the 2000 Giro d'Italia, Tour de France and Vuelta a Espana. Professor Lucas discovered the preferred cadence during the high mountains averaged 71rpm, compared to 89rpm during flat time-trials and 92rpm in long, flat road stages.

If the pros can't decide which is the most efficient cadence, what hope is there for us? Plenty, according to sports scientist Dr Garry Palmer. 'If you have a cadence of 60-70rpm, from a neurological point of view that's more economical than having a cadence of 100-105rpm, but lactate build-up means it fatigues the muscle much faster. Someone training three or four hours a week might find they naturally develop their riding at a low cadence, which is why a lot of sportive riders will have a cadence of 75rpm. They've developed muscular strength by doing the minimal amount of training, but if they'd done more cardiovascular work, they'd be able to handle riding at a higher cadence.'

Froome's average cadence for his 41min 28sec ascent was 97rpm. During the attack that blew his rivals apart that rose to 120rpm

Riders such as Fausto Coppi were renowned for their fluid pedal stroke, and the French even have a name for it: *souplesse*. The movement is poetry in motion and, visually, it appears that no energy is leached. According to Bailey, though, looks can be deceiving: 'Many "biomechanical" factors have been identified when trying to improve efficiency, but things like crank length and the pattern of force application [mechanical effectiveness] don't influence efficiency. Coaches promote "optimal" pedalling techniques to improve efficiency, but direct assessment has shown that even unusual pedal styles can be efficient. Pedalling without cleats, using uncoupled cranks and altering pedalling stroke are examples of current training techniques that supposedly improve pedalling technique and efficiency. Sadly, there's a lack of scientific evidence to support them.'

Cadence

While a smooth pedal stroke is aesthetically pleasing, what's more proven to have an effect on efficiency is cadence. Team Sky offered an insight into cadence by releasing data from Chris Froome's winning ride on Stage 10 of this

In short, maintaining a higher cadence requires greater fitness but is more efficient if you can achieve it. This is the eternal problem for sportive riders. To improve cardio fitness requires time – long, regular rides to force a number of physiological adaptations, which include better bloodflow to the muscle, more efficient energy transfer and an increase in mitochondrial density. 'Mitochondria are micro-organelles in the muscles and responsible for burning fat and carbohydrates for fuel,' says Palmer. 'Research has found that trained individuals show a 400% increase in mitochondria density over sedentary folk.'

Basically, long hours in the saddle will result in improvements in every physiological parameter that speeds you up, meaning you will use less effort for the same speed. That ○

MASTERS OF THE ART

The art of pedalling with fluid efficiency so that man and machine are truly one organism is known as 'souplesse'. These three had it in spades...

FAUSTO COPPI

The Italian won two Tours and five Giros d'Italia between 1940 and 1953, and he did so with an effortless style that drew praise from twice-winner André Leducq: 'He seems to caress rather than grip the handlebars, while his torso appears fixed to the saddle. His long legs extend to the pedals with the joints of a gazelle. At the end of each pedal stroke, his ankle flexes gracefully. It's as if all the moving parts turn in oil. He rides like a great artist painting a watercolour.'

DAVID MILLAR

'We have brought an element of bespoke tailoring and sartorial elegance to the world of high-performance technical wear,' the Scot said at the recent launch of his new clothing range, Chpt.III. But it was Millar's pedalling style that captured the cycling aesthetic of fluidity and grace. Either side of a two-year ban for doping in 2004, Millar won five stages of the Tour de France, two at the Giro and five at the Vuelta.

ROGER DE VLAEMINCK

'Four kilos of pressure in the front tyre and five in the back – that's more than enough. Your gears are also important. I always tried to ride on the cobblestones using a *souplesse* pedalling motion.' Those were the words of Belgian Roger De Vlaeminck when describing his technique. It clearly worked as his playboy reputation and love of fast cars didn't detract from a palmares that included four Paris-Roubaix victories.



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IMPROVE YOUR EFFICIENCY

Three ways to maximise every pedal stroke...

INCREASE CADENCE

Consensus among coaches and numerous studies suggests a cadence of 90rpm is optimal to avoid fatigue and maximise speed. This increases the power derived from the cardiovascular system, rather than relying on the more rapidly fatigued muscular system. A simple method to increase cadence is to lower the gear and aim to keep the same road speed. Interval training also helps.

RAISE YOUR VO_2 MAX

Improving your aerobic system will make everything more efficient: your fat and carb metabolism, the transfer of oxygen from blood to the muscles and your climbing ability. Key to raising your VO_2 max is long, slow to medium-intensity rides. Two hours plus at conversational pace will burn fat, which increases the number of mitochondria in your muscle cells. Increase these and you'll extract more oxygen for every breath, meaning you can train harder and faster, but still use fat rather than glycogen as the primary fuelling source.

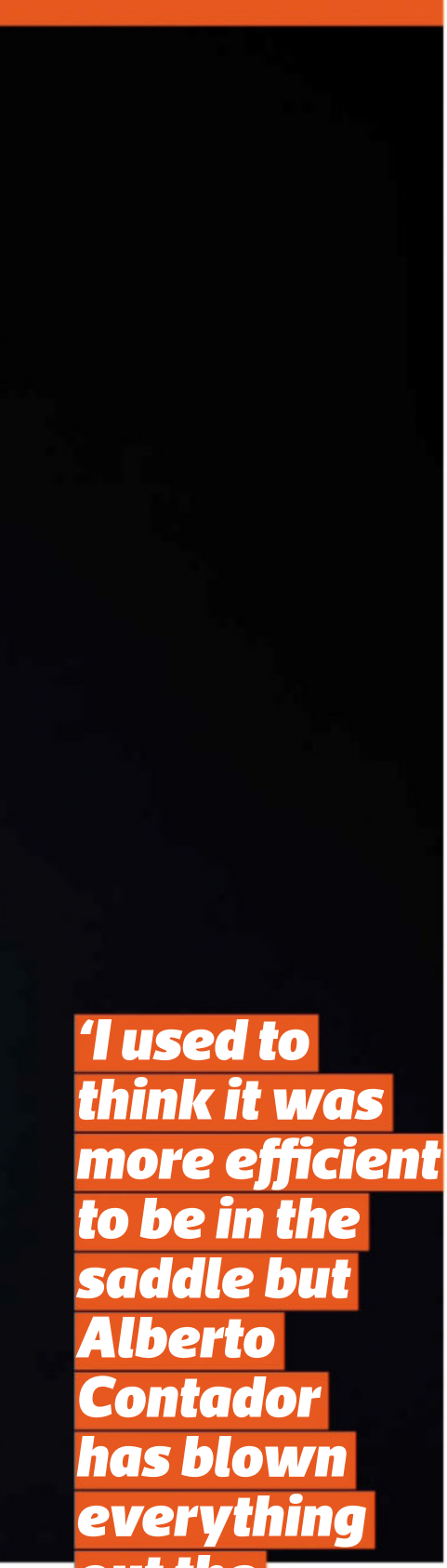
CLIMBING TECHNIQUE

Mimicking Froome's pace as you ascend your favourite climb will be that bit easier if you're an efficient climber, and much of that boils down to your style. Heavier riders are advised to remain seated longer than lighter ones as the saddle bears much of their weight. But research also suggests standing when you hit 86% maximum power output is more efficient than remaining seated.

said, muscular strength – or more accurately, muscular composition – might play a role in more efficient performance.

'Changes in muscle fibre composition may be responsible for improved cycling efficiency,' says Bailey. 'High-intensity training, training at altitude and strength training have been shown to improve cycling efficiency. The precise mechanisms aren't fully understood, but all methods can lead to reduced oxygen cost for a given submaximal cycling intensity, either by improvements in the efficiency of metabolic pathways to deliver energy for muscular contraction or the increased recruitment of Type I [slow-twitch] muscle fibres.'

And as cycling efficiency is directly linked to the oxygen cost required to sustain a given power output, any biochemical or metabolic adaptation that improves this process is likely to be linked to improved efficiency.



‘I used to think it was more efficient to be in the saddle but Alberto Contador has blown everything out the window’

It’s accepted that Type I muscle fibres are better suited to endurance sports such as cycling. Yet despite much research into the area, no clear relationship exists between muscle fibre composition and cycling efficiency in trained versus untrained cyclists, according to Bailey.

Substance over style

That uncertainty extends to climbing efficiency. Nairo Quintana seemingly ascends with the metronomic grace of a Patek Philippe watch. Froome, on the other hand, has the frenetic style of a man being attacked by a swarm of bees. Surely he could improve his efficiency?

‘Clearly not, as he’s one of the best climbers in the peloton,’ says Palmer. ‘There’s an argument that you could try to change Froome’s style in the hope of becoming more efficient but he’s at the pinnacle of his sport.’

Froome’s not the only sportsman whose style might be less than textbook but has achieved outstanding results. Marathon runner Paula Radcliffe’s bobbing head looked inefficient. At 200m and 400m, Michael Johnson’s pigeon chest and stiff back propelled him to four Olympic gold medals. In golf John Daly’s Happy Gilmore-style swing won him two majors.

‘It’s different with a club rider,’ says Palmer. ‘They can achieve significant gains through better technique because they have greater potential to improve. But, again, it’s an individual thing which method of climbing is more efficient – seated or standing.’

Studies have supported what we’ve all experienced on those undulating Sunday morning rides – that seated is more efficient until you hit a certain intensity. Professor Ernest Hansen showed that up to 86% of maximum power output, seated proved more efficient. This would represent a shallow, long hill. When things get steeper, for instance when the hill hits 8-10%, standing is more efficient.

‘There are many reasons why,’ says Daniel Healey, head of sports science at Tinkoff-Saxo. ‘Beyond activating more muscles, while standing the rider can produce greater leverage from the bars – just look at Chris Horner’s super-wide bars [46cm] when he won the 2013 Vuelta.’

Outliers continue to ride roughshod over the rulebook, though. ‘I used to think it was far more efficient to be in the saddle but now I’m in a team with Alberto Contador, he’s blown everything out the window,’ says Healey. ‘When you watch him, the central part of his body down to his hips swings from side to side. It’s almost a slinky movement that gives him that little extra push every time. And that goes against the grain, too. I always thought you should have a rock-solid core – no movement left and right – for greater efficiency. I guess with Alberto’s technique there may be some elastic muscular benefits. He’s an anomaly but has made me completely rethink my advice on riding in the saddle. Now I say do what feels comfortable.’

Another aspect of efficiency is pacing. It’s all very well being efficient over 10km, but if your sportive is 100km-plus and your efficiency plummets, you’ll blow before the first feedzone.

‘Efficiency can degrade during long rides and even after shorter, high-intensity efforts,’ says Bailey. ‘In both cases it’s probably linked to the effects of fatigue. With that in mind, optimal pacing involves finding a balance between sustaining the highest intensity possible while trying to minimise the effects of fatigue.’

This is where a tool such as the power meter comes into its own, which can help a rider maintain an appropriate power output for optimum performance. Of course, theory is one thing, real life is different. With competitive juices flowing, sticking to a pre-determined power output and the uneven speed profile it brings may be unrealistic. You may instead find negative splitting is more efficient, where you start slowly and then ride progressively faster as the race progresses.

‘Both are valid and efficient pacing strategies,’ says Bailey. ‘The best time-trial riders demonstrate even-paced performances, though the elusive “negative split” is good to minimise the negative effects of fatigue during a race and maintain high efficiency.’

Perhaps the most realistic pacing strategy for many recreational riders is the double peak. This is where you start and finish strongly, easing back in the middle. With adrenaline coursing through your veins, it’s hard to restrain yourself from going all-out at the beginning. The same is true when the finish line is on the horizon. This double-peak template might not be as efficient as even pacing but, if it’s practised in training, it can lead to strong performances.

The final reckoning

Ultimately, the fitter you are, the more efficient you’ll be as a cyclist. You’ll burn more fat as fuel, send more oxygen to the muscles with every breath and go further with every pedal stroke. Professor Asker Jeukendrup calculated that increasing gross efficiency by 1% for a 70kg cyclist who could maintain a 400-watt average for one hour would result in a 48-second improvement in a time-trial. Of course, those are professional figures but you get the point: less energy wasted equals more speed. Couple that with the free gains afforded from improved aerodynamics and refined skills, like cornering and handling, and it won’t be long before you’re leaving your mates for dead – all in the name of efficiency, of course.

James Witts is a freelance writer who has never been known to waste energy unnecessarily

TRUE DETECTIVE

Journalist David Walsh talks to *Cyclist* about his 13-year pursuit of Lance Armstrong, his issues with Team Sky, and seeing his book turned into a new Hollywood movie

Words **MARK BAILEY**
Photography **ALEXANDER RHIND**

When Lance Armstrong won the Tour de France in 1999, David Walsh wrote in *The Sunday Times*: 'There are times when it is right to celebrate, but there are other occasions when it is equally correct to keep your hands by your sides and wonder.' Sixteen years later, having been vindicated in his assertions that Armstrong was a liar and a cheat, Walsh's hands are neither applauding the demise of Armstrong, nor punching the air in celebration. As the 60-year-old journalist from Slieverue in County Kilkenny sits in the garden of his family home in Suffolk, his hands are nursing a mug of tea and a scone smothered in jam. The immediate impression is one of a contented journalist and grandfather relaxing at home, not a victor revelling in glory. Walsh is no longer wondering if Armstrong will be caught, only whether he has any desire to see the American again.

'I don't know, maybe at some point I would. I don't really have any great desire to, but if he initiated it,' considers Walsh. It's the one question to which he genuinely seems uncertain of his answer in an hour-long interview that otherwise resonates with the clarity, passion and sincerity that characterised his years in pursuit of Armstrong. 'I know Lance continues to say to journalists that he absolutely hates me, that he thinks I'm the bad guy.

'If I did meet him I wouldn't want it to be in public. I wouldn't want to write about it – just he and I having a private conversation. And I would be saying to him, "Go away and live your life quietly, stay out of the public

Walsh doesn't believe Lance Armstrong has told or ever will tell the whole truth: 'I think he still thinks he can get away with it. Get away with not telling the whole truth. Get away with keeping a lot of his ill-gotten gains'



light, and find a way to tell the whole truth. Break yourself down in order to build yourself back up. But break yourself down properly, not selectively." And I don't think he has a mind to do that. I think, in a way, he still thinks he can get away with it. Get away with not telling the whole truth. Get away with keeping a lot of his ill-gotten gains.'

The toll

A call from a 001 512 number in Austin, Texas, is unlikely to flash up on Walsh's mobile any time soon. But to observe Walsh at home – sharing jokes with his wife Mary, talking in his soft Irish lilt about his seven children, Kate, Simon, Daniel, Emily, Conor, Molly and John, who was tragically killed in a cycling accident, aged 12, in 1995, and his beloved grandchildren – provides an essential reminder that at the heart of the dark Armstrong saga are human beings with families, emotions, careers and lives to live, repair and enjoy.

With so many heroes, heroines and villains, the story is a director's dream and a new Hollywood movie about the Armstrong affair is in cinemas in October. Called *The Program*, it is an adaptation of Walsh's 2012 book *Seven Deadly Sins: My Pursuit Of Lance Armstrong*, directed by Stephen Frears (*The Queen*, *High Fidelity*) and starring Ben Foster (*3:10 To Yuma*, *The Messenger*) as Armstrong and Chris O'Dowd (*The IT Crowd*, *Thor: The Dark World*) as Walsh. But this is a true story, and the grim daily grind for those involved is equally poignant.

Walsh suffered vitriolic personal abuse. Armstrong dubbed him a 'little troll' and a *Sunday Times* reader suggested he had 'a cancer of the spirit'. He faced the professional humiliation of witnessing journalists – friends – deny him access to their car at the Tour, lest they be tainted by association. He endured bruising litigation, with *The Sunday Times* forced to settle a libel case with Armstrong (it has since recovered its money).

In a touching entry in Walsh's book, his wife Mary writes of the endless questions from strangers: 'Lance followed us everywhere – to dinner parties, weddings, gatherings in the village hall.' Walsh can recall cutting short a hike in the Himalayas in 2010, scrambling to an internet cafe in the remote town of Pheriche to read the news that former US Postal rider Floyd Landis had implicated Armstrong.

'I knew we were being sued and I was going down to London for meetings with barristers endlessly,' says Walsh. 'But it never felt bad

Lance dubbed him a 'little troll' and a *Sunday Times* reader suggested he had 'a cancer of the spirit'

to me. It never felt tough. I wasn't lying awake at night worrying. We discussed it as a family when we sat around the table. The kids would have a laugh and tell me, "Dad, he is never going to be caught." They didn't ever worry that I was wrong but they did feel Lance would get away with it, as did I.' He chuckles at a memory. 'When the kids saw the trailer for the new movie that shows me ranting, "The man is a cheat!" they said, "Dad, we have heard you say that so many times!"'

Walsh refuses to allow violins to form the soundtrack to his story. 'It was my job. I was being paid,' he says. 'And I was helped by the fact I worked for a Sunday newspaper. I could get away without having access to Armstrong. If you were a daily journalist your life was going to be much more difficult. I have often wondered: if you were from a daily, would you have compromised your access to Lance? No, I wouldn't, but I would always have felt I was being a fake.'

What upsets Walsh is the impact on his sources and the riders who risked it all. 'They were the ones who had it tough,' he insists. Emma O'Reilly, the US Postal soigneur who smashed cycling's insidious *omerta*, was labelled an 'alcoholic whore' and bombarded with subpoenas. Christophe Bassons, the outspoken anti-doping French rider, was bullied out of the peloton, his life symbolic of the invisible generation of cyclists whose careers were crushed. 'The single greatest driving force for my wanting to tell the truth is represented by the person Christophe Bassons was,' says Walsh. 'It's not about going after Armstrong. It's about standing up for Bassons.'

Simple questions

Walsh treasures a story about his late son, John. On learning about the nativity, and hearing that Mary and Joseph were visited by three wise men bringing gifts of gold, frankincense and myrrh but later lived a humble life in Nazareth, John

WALSH VERSUS LANCE

HISTORY OF A DOPING SCANDAL

1993 Walsh first interviews Armstrong, then a 21-year-old Tour de France rookie. Armstrong talks openly about the 'desire' and 'rage' that fuels him.

1999 In *The Sunday Times* Walsh voices his suspicions about Armstrong's first Tour win, three years after the American's diagnosis for cancer in 1996.

2001 Walsh reveals that Armstrong has been working with controversial Italian doctor Michele Ferrari.

2003 Walsh's explosive book *LA Confidentiel*, co-authored with French journalist Pierre Ballester, is released in France, with witness reports of Armstrong's doping. Libel laws prevent its publication in the UK.

2004 Armstrong launches a libel action against *The Sunday Times* for an article, based on the book, which made allegations of his doping. The newspaper pays £300,000 to settle.

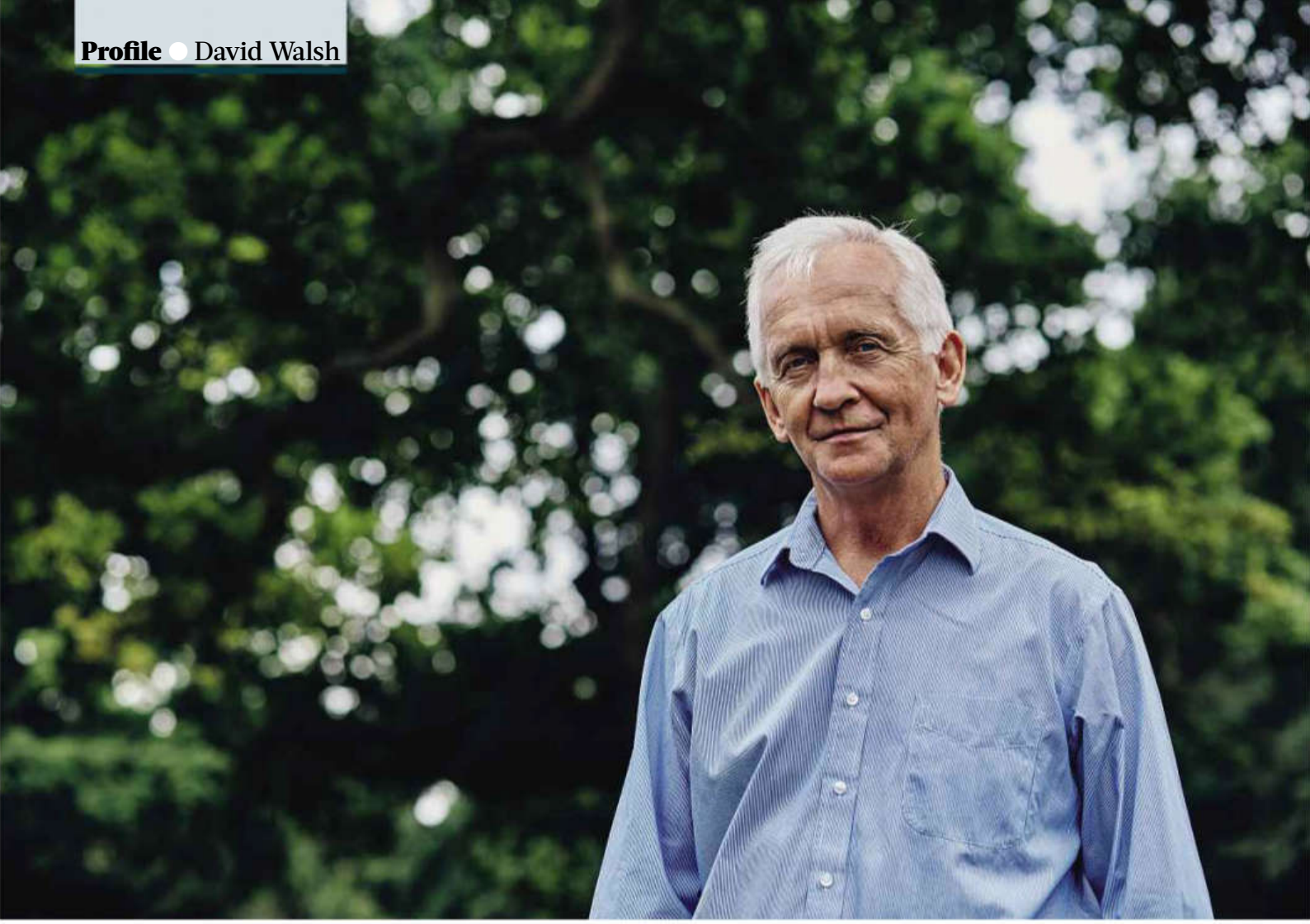
2005 Armstrong wins his seventh Tour title, announcing, 'I'm sorry you don't believe in miracles.'

2012 An investigation by the United States Anti-Doping Agency reveals Armstrong to be part of the 'most sophisticated, professionalised and successful doping program that sport has ever seen'. Walsh chronicles his 13-year investigation in the book *Seven Deadly Sins*.

2015 Walsh's 2012 book is turned into a Hollywood movie called *The Program*, directed by Stephen Frears.



A stable home life and supportive family helped Walsh through the difficult times. 'They didn't ever worry I was wrong but they did feel Lance would get away with it, as did I'



asked his teacher Mrs Twomey: 'What did they do with the gold?' She hadn't been asked that question in 33 years of teaching. 'That is what journalism is about,' thought Walsh. 'That's the way I need to be for the rest of my life.'

His investigation into Armstrong was founded on asking those same, simple, incisive questions: how could an athlete increase his time-trial performance by eight seconds per kilometre between 1993 and 1999, when in 1996 he was having a testicle, lung cysts and brain lesions removed? How could a rider with a VO_2 max of 83 obliterate Christophe Bassons, who had a VO_2 max of 85, by 26 minutes on a mountain stage?

The journalist also had to ask himself an important question: in an era of widespread doping, why target Armstrong? 'There were a lot of factors but the biggest one is that he had become a global icon,' says Walsh. 'Lance resonated around the world and if he was a fraud, well, bloody hell, what are we saying to our kids? That it's OK to cheat and get away with it? That you can become one of world's most famous people and be flying everywhere in a private jet, socialise with Hollywood superstars and have a rock-star girlfriend? If he was pulling the wool over our eyes it was a heck of a deception.'

Walsh also thought Armstrong's aggressive verbal attacks on people were 'outrageous' and his lies to the cancer community shameful. 'On the one hand he has got this charity [Livestrong] which is trying to do so much for people with an appalling disease. But on the other hand he is lying to their faces, so how much respect had he for those people?'

Does Armstrong's character and status justify the witch hunt, given that his peers escaped with lesser bans and successful riders from earlier generations such as Stephen Roche and Miguel Indurain don't suffer the same suspicions? 'Maybe it's a hardline view but I think what Lance has got, he pretty much had coming to him. I think other guys have got away with cheating, and not being caught, and not having their reputations properly investigated.

'I wrote a story in 2002 about Stephen Roche coming up in an [Italian] judge's report where Judge Franca Oliva said Roche and his Carrera teammates did receive EPO from Professor Francesco Conconi. Indurain has never had any real focus on him in that way. But Lance was like a guy in a poker game who always wanted to up the ante, to get more chips on the table, so his pot kept accumulating but it made him more vulnerable.'

'There are many shafts of light that comprise most human beings, some dark, some bright. Lance is no different'

Walsh was shocked when his book was turned into a movie. 'They were showing me scripts, asking for feedback, then pretty much ignoring all of it,' he says with a smile

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SCOTT

Walsh says he felt no sense of vindication or pleasure when Armstrong was stripped of his seven Tour titles. 'I felt uncomfortable now being on the same side as [former UCI President] Pat McQuaid. He should have had the good grace not to associate himself with kicking Armstrong out of the sport because that felt like poacher turned gamekeeper. I saw [former US Postal managing director] Johan Bruyneel was at Wiggins' Hour record in the centre with McQuaid, having a drink like long lost friends, and I thought: Pat, if you are genuinely affronted by what these guys did, if it's a shock to you that they were doping, and had such a deep antagonism towards the fraud perpetrated by Bruyneel and Armstrong and their entire team, you wouldn't want anything to do with Bruyneel. But that evening in London we saw something closer to the reality.'

The Program

Walsh was shocked and humbled to hear that his book would be turned into a movie. He was consulted throughout by the film's production company Working Title – makers of *Frost/Nixon*, *Senna* and *The Theory Of Everything*. 'They were very respectful, showing me scripts, asking for feedback, then pretty much ignoring all of it,' says Walsh, smiling.

The triumph of the film is in not over-simplifying the protagonists. Decent men prove to be meek journalists. Armstrong, however ruthless, was capable of kindness. Walsh highlights a take that he hopes makes the final cut. 'There was a scene in which a woman gets her book signed by Lance Armstrong and says, "I am alive because of you." And he looks really uncomfortable, because he knows he's a fraud. Suddenly he is confronted with this woman – a very ordinary person – and Lance was her inspiration. I thought it was tremendously important. There is another scene with Lance and a kid [suffering from cancer] which is very authentic. Lance wouldn't be the most natural guy with kids but you can see he is trying and he is moved because how could you be human and not be moved? The film shows Lance in all his complexity, good and bad. There are many shafts of light that comprise most human beings, some dark, some bright, some in between. Lance is no different.'

Froome under the microscope

The shadow of Armstrong continues to hang over professional cycling today. Tour de France winner Chris Froome and Team Sky bear the brunt of the lingering suspicion. After spending a year inside Team Sky, Walsh believes the team is clean but he remains critical.

'I would love Lance to leave you with the sense that he had genuinely told you everything'

'They need to do more,' he says. 'Chris Froome has said he will be tested independently. Once you've said that, you've got to do it. Much of it [their unpopularity] is something they can't control: it's anti-Murdoch, it's anti-one team being successful, there is an anti-British element. But they should be doing more. Tim Kerrison [head of athlete performance] said after Froome's performance on Col de la Pierre St Martin that he has done 15 better performances than that in the last four years. So why not put them all out there and let people see that Chris Froome does incredible rides in training? I have spent time at training camps, saying to whoever is driving the car, "Does Froome train this full-on every day?" And they say, "Yeah." He sometimes trains on his own as he feels the intensity he wants can be compromised by other riders.'

Walsh investigated Froome before agreeing to ghost-write his autobiography *The Climb* in 2014. 'At this point in the Armstrong story I had six people in the team saying he had doped, and loads of evidence. With Froome, nothing. So what am I supposed to do? Make it up? Just so I can seem like a real tough guy who believes in nothing when I think there is a really decent basis for trusting Sky and Froome? When Lance was telling you he was using an altitude tent, you find out he's not and you realise he is a liar. Stuff like that hasn't come out about Geraint Thomas, Chris Froome or Bradley Wiggins? With Armstrong there was always that flow of evidence.'

In the Armstrong era a generation of clean riders were let down by the drugs cheats. With Froome soaked in urine and spat at during the 2015 Tour, is there a danger that the current generation of riders is being let down in a very different way, by an aggressive suspicion that fails to acknowledge sporting achievement?

WALSH ON...

... THE UCI

'In 1999 there was not a test for EPO but we knew from health checks that a lot of the cyclists were using EPO. Why not freeze the samples and say we are going to have a test in 14 months? Imagine what it would have done for the sport if they had redone Lance's samples and all of them were positive. Imagine if they had suspended 70 riders for two years? It could all have ended there and then. But they didn't have the stomach for that.'

...LIVESTRONG

'There is no doubt in my mind that when Armstrong set up Livestrong he did it with the right intentions. It did become a shield, but I feel a lot of work he did was genuine. But it also significantly improved his earning power. I remember when Lance was a big name on the speaking circuit I would find people who were organising a big cancer fundraiser and thought they could get Lance. They realised they could get him but they had to pay him a significant amount of money.'

...ONE DAY AHEAD

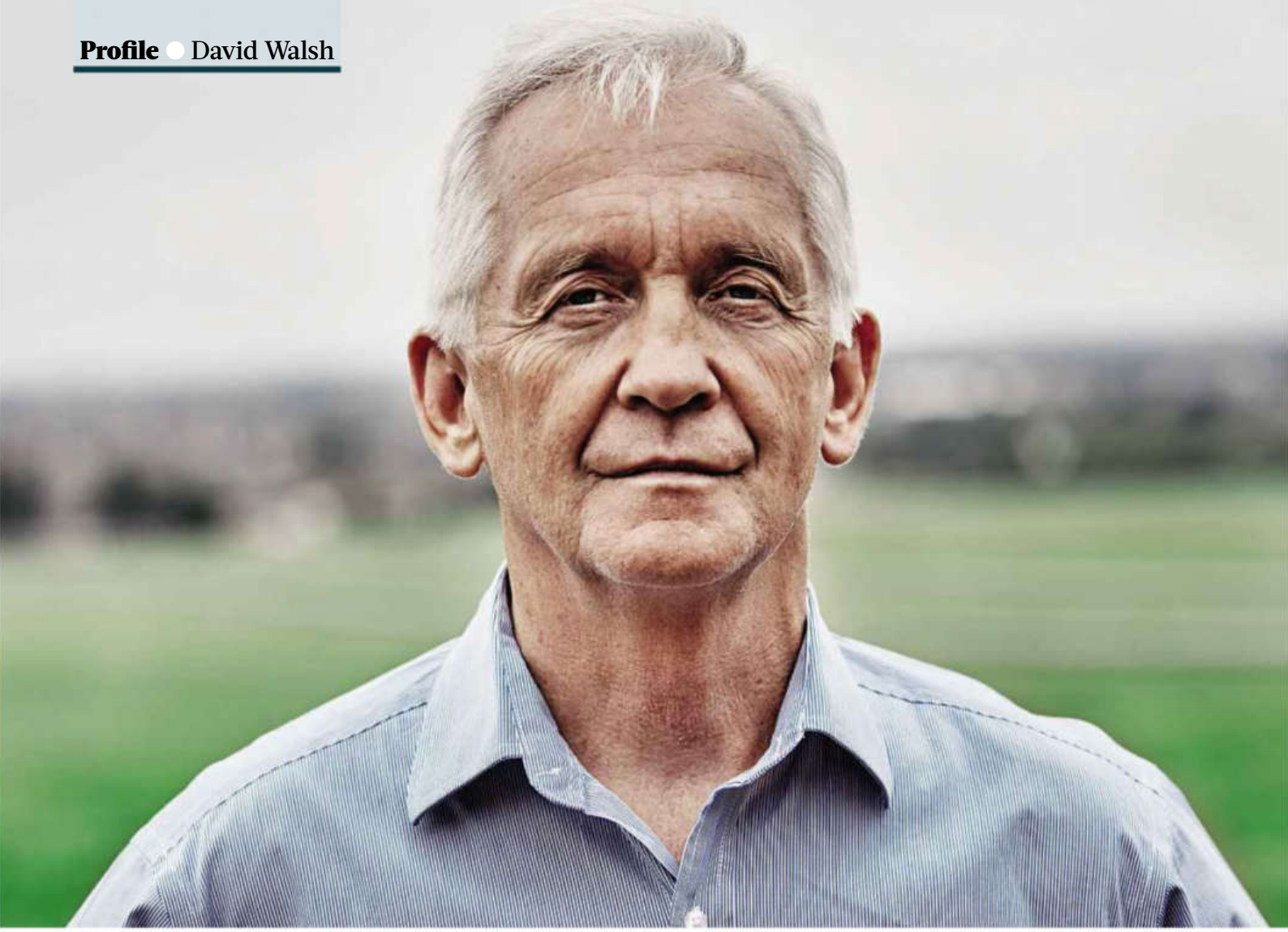
'I know [ex-footballer and leukaemia survivor] Geoff Thomas, who took Lance on the One Day Ahead tour [in July 2015], was adamant that it was a good thing. I wonder. I am sure he has raised more money and awareness and that's a good thing, but he has associated his charity with a man who is a complete fraud and a bully who tried to destroy people's lives.'

...TWITTER TROLLS

'Social media is tremendous for allowing people to exchange views but I wish it could be done in a more polite, civilised way. It amazes me that people think they can go on Twitter and insult you in a way that in a bar would end up in a fight.'



Walsh believes Team Sky are clean but need to do more: 'Why not let people see that Chris Froome does incredible rides in training? He sometimes trains on his own as he feels the intensity he wants can be compromised by other riders'



'Yes, I think there is a real danger,' Walsh says. 'What happens in 15 years' time when we become pretty convinced that Chris Froome did it all clean? Do we say we were terribly unfair? People who are accusing him will feel the questions are justified. I would say the questions are justified, but with no answers to justify the questions it should have stopped at scepticism and not gone into suspicion, hostility and accusation.'

The future

One problem for modern cyclists is that the events of the past have yet to be fully settled. Who is innocent and who is guilty? Walsh believes the ongoing US Justice Department lawsuit, which claims Armstrong defrauded the government-sponsored US Postal team, might prevent him opening up. 'That potentially could have a very big financial penalty for Lance and maybe he is very worried about that and maybe that stops him telling the truth about lots of things. But am I the only one curious about what exactly did [Armstrong's lawyer/agent] Bob Stapleton know? What exactly did [US Postal backer] Thom Weisel know? How involved was Mark Gorski when he was general manager of US Postal? Somebody as low down as a Dan Osipow, the PR guy, did Dan know? Did Jim Ochowicz know when they were at Motorola? I would love Lance to go into that stuff in great detail and leave you with the sense that he had genuinely told you everything, because I don't have that sense at all.'

Walsh is unsure whether Armstrong has the humility to fully unburden himself of his secrets then quietly retreat into the shadows. He highlights Armstrong's ill-fated comeback in 2009 and his controversial and antagonistic involvement in the footballer Geoff Thomas's One Day Ahead charity bike ride during the 2015 Tour as evidence of a man who craves the oxygen of publicity.

'What I've seen is a guy who is desperate to become relevant again, to become part of the conversation,' concludes Walsh as our interview draws to a close. 'I think mostly he is sorry for being caught.'

Ruthless, ambitious, egocentric, perhaps Lance Armstrong would never have been happy with a career founded on bread and water. David Walsh is about to see his professional endeavours immortalised in a Hollywood movie, but you sense he would be quite content with that scone and tea.

The Program *is out on 16th October*

'People who are accusing Chris Froome will feel the questions are justified, but it should stop at scepticism and not go into hostility'

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Run for the hills

Cyclist discovers a ride of barren beauty and dark history in the mountains of north-east Scotland

Words **TREVOR WARD** Photography **GEORGE MARSHALL**





A series of global catastrophes ranging from the Ice Age to World War One conspired to shape and sculpt the landscape of the Scottish Highlands. All those slowly moving glaciers carved the distinctive topography of the Cairngorm mountains, while the call to arms was answered by hundreds of men from the Cabrach, where their abandoned, crumbling farmhouses still stand today like neglected tombstones. One historian called this expanse of bleak, rolling moorland 'the biggest war memorial in Europe'.

But Wilma, the landlady of the Grouse Inn, is having none of this. While she doesn't dispute the geological origins of northern Scotland's glens and Munros, she's unequivocal about who's to blame for the derelict settlements that haunt this remote part of Aberdeenshire.

'It's all your fault,' she says after I've popped in to view the pub's famous collection of more than 700 bottles of whisky. She's referring to my aristocratic English ancestors who owned vast swathes of land up here and evicted hundreds of tenant crofters during the 18th and 19th centuries in what became known as the Highland Clearances. But even with my limited grasp of 'historical atrocities committed by the English', I know this isn't true. As local historian Norman Harper told a BBC Scotland TV documentary: 'The Cabrach is Scotland's testament to the waste of young life in wartime. The great numbers of tumbledown crofts and steadings you see happened not because of land policy or the Depression or a series of bad farming years. They happened because virtually all the fighting-age men and boys went off to war in 1914. Many did not return.'

I think better of correcting Wilma. Her pub is literally in the middle of nowhere, there's some burly agricultural types sitting in a corner, and the sudden, unexplained disappearance of an English cyclist in these parts would probably be considered no more newsworthy than rain.

So, in a bid to diffuse the situation, I change the subject to something less emotive, like why I've clip-clopped into her pub wearing Lycra and a helmet. Big mistake. Her antipathy towards cyclists appears more ingrained than her historical revisionism. Referring to a local sportive that uses the road outside, she says, 'All those cyclists affect my business. How are my locals supposed to get here?'

Little does she know that my riding companions today are the organisers of the event – the King of the Mountains Sportive – but they have opted to wait outside, having previously experienced Wilma's obstinacy (she wouldn't let them use her car park as a feed station). As if walking across a slippery pub floor in cleats isn't difficult enough, I now feel as if I'm treading on eggshells too.

I'm just about to ask Wilma about the 'locals' she refers to when a minibus of American tourists arrives – the most expensive whisky is £13 a nip – so I make my excuses and leave.

Outside, Jon Entwistle and Richard Lawes aren't at all surprised by my experience.

Wilma is unequivocal about who's to blame for the derelict settlements that haunt this remote part of the country. 'It's all your fault,' she says



Previous pages: The climb up to Strone that starts at Balmoral. Prince Charles's favourite mountain looms large

Right: Just cresting the 20% ramp on the way to the Gairnsheil climb

Below: Gairnsheil humpbacked bridge is a cat 3 climb in its own right, and the scourge of local minibuses





Cairngorm circuit

Follow *Cyclist*'s Scottish excursion

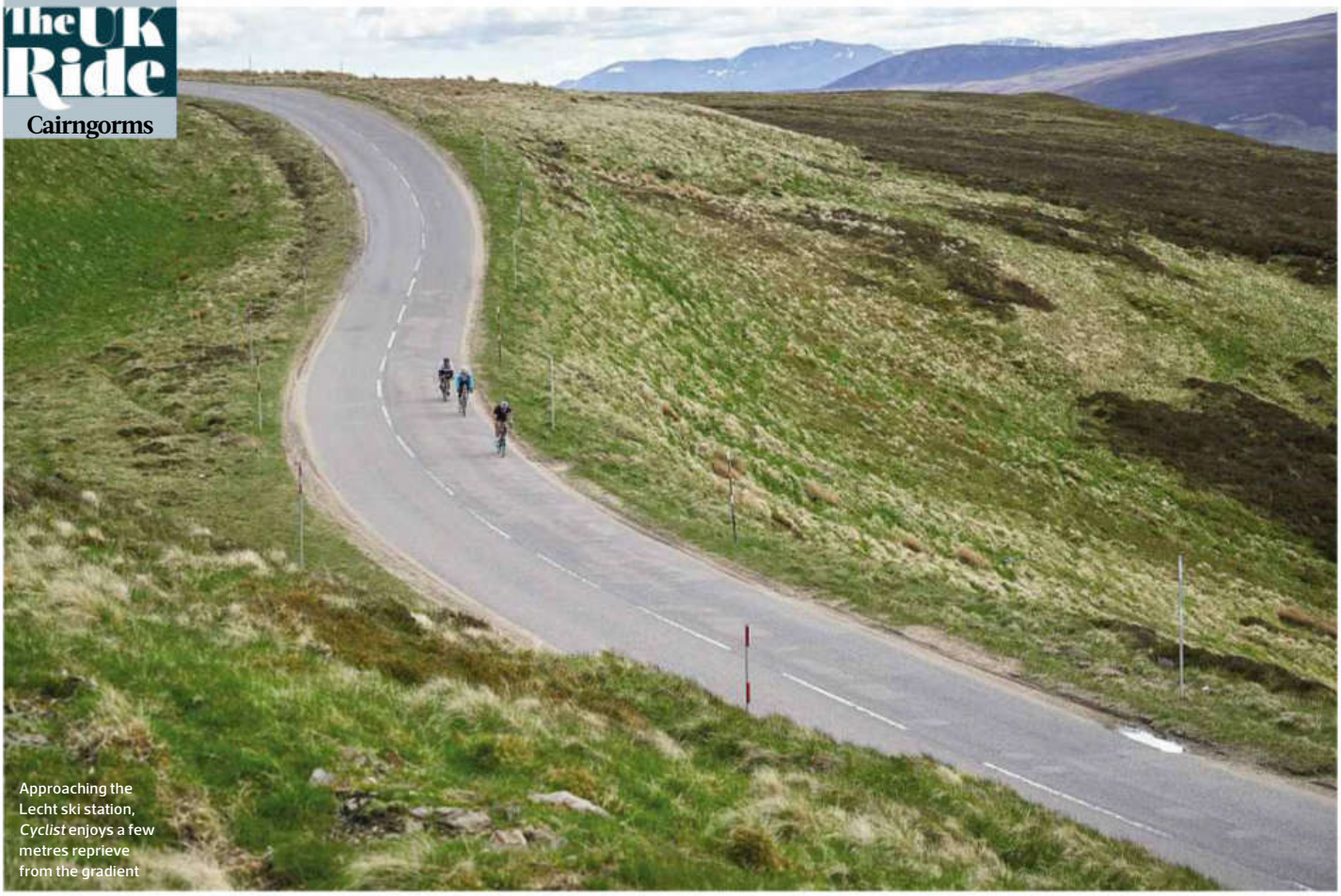
To download the route, go to cyclist.co.uk/41cairngorms. From the centre of Ballater, take the B976 towards Crathie. At Crathie, turn left on the A93 and then right on to the B976. A kilometre before Tomintoul, turn right at the T-junction on to the B9008 towards Dufftown. In Dufftown, follow the road to a T-junction at the bottom of the hill and turn right in the direction of Huntley. Turn right again on to the A941, signposted Cabrach. Keep on this road until there's a junction on your right, signposted B9002 to Lumsden. Turn right. At the T-junction with the A97, turn right towards Lumsden and Alford. Keep on the A97 towards Lecht Ski Centre. Follow the road to Towie. Turn left at the A97 crossroads towards Ballater and continue until a crossroads with the B9119, then turn right. At the A93 T-junction, turn right again and follow the signs to Ballater.



Distance
149km

Elevation
2,127m





Approaching the Lecht ski station, *Cyclist* enjoys a few metres reprieve from the gradient

Jon and Richard are both self-styled cycling crusaders who prefer using education over mere confrontation

'When we were planning the route of our event, we offered to make it profitable for her by either making a donation or steering riders into the pub for alternative refreshments, but she really wasn't interested,' says Jon. 'I don't think she's in any danger of appearing on *Dragon's Den* or *The Apprentice* any time soon.'

Back to the start

When I begin the ride with Jon and Richard, I'm surprised they're not wearing capes and masks. The pair are self-styled cycling crusaders, but instead of wearing helmet cams and waving burning crucifixes at anyone driving a car, they prefer a more subtle campaign of education rather than confrontation. As we leave the pretty village of Ballater on the banks of the Dee and follow the undulating, leafy road in the direction of Balmoral, Jon explains their mission: to make this part of Scotland like a 'mini-Holland'.

'Most people own a TV which they regularly use,' he explains. 'Most people own a car, which they regularly drive. And most people have a bike in their house but they don't tend to use it. We want to see children cycling to school, families cycling to the shops and parents cycling to work.'

Though schools, shops and places of work will be few and far between on today's ride, across some of the most sparsely-inhabited landscape in the UK, it's easy to see how this part of Scotland could become the seat of a cycling revolution – the roads are quiet and in decent nick, and there's no heavy traffic. It's just a shame about the mountains; three of the climbs ahead of us today are among the eight highest roads in the country.

The first of these is a narrow strip that threads through forested lower slopes before emerging onto an expanse of purple-hued moorland that offers views of the cauldron of snow-capped Cairngorms to our left. By the time we reach the top of the final ramp, we have risen 200m in less than 5km, and yet I notice that Jon and Richard have remained seated all the way up. It turns out they are advocates of the Chris Froome school of ascending. Both British Cycling-certified coaches, they believe staying seated and spinning a high cadence is the most energy-efficient way to get up a mountain. In photos, however, this technique doesn't look particularly exciting – they may as well be sitting on the sofa at home reading a phone

Rider's ride

Merida Ride 5000, £1,800, merida-bikes.com

The Ride range is aimed at sportive riders, resulting in a bike that's slightly heavier than those in Merida's Scultura range. The 5000 still managed to feel 'racy' during a long day in the saddle, however. While the geometry may be designed for comfort on long rides, its abilities as a racer haven't been compromised. This was especially noticeable on the climbs. Sure, it was heavier than a bike costing twice the price, but it never felt as if any of my efforts out of the saddle were being wasted. There was a direct response from a frame that's stiff and yet, thanks to its Flex Stay seat and chainstays, still manages to smooth out unexpected bumps and lumps. The boxy-looking chainstays do a brilliant job of reducing vibration. The special edition Fulcrum wheels aren't light, but felt faster and more reliable than other entry-level wheelsets. Overall, it was a real joy to ride.



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‘See that patch of snow over there? That’s one of the top three longest-lasting patches of snow in the UK’

directory. So with a bit of polite cajoling from our photographer, they agree to click down a sprocket and climb out of the saddle. Now at least it doesn’t look as though it’s only me putting in some effort on the 15% slopes.

At the top of this first climb, the Strone, we pull in to a passing place to enjoy the views. ‘See that patch of snow over there?’ says Jon, pointing to a distant peak with a barely pronounceable Gaelic name. ‘That’s one of the top-three longest lasting patches of snow in the UK. It was in *Weather* magazine.’

I look in the direction Jon is pointing and consider what he’s just told me. ‘I know,’ he says, ‘I should probably get out more.’

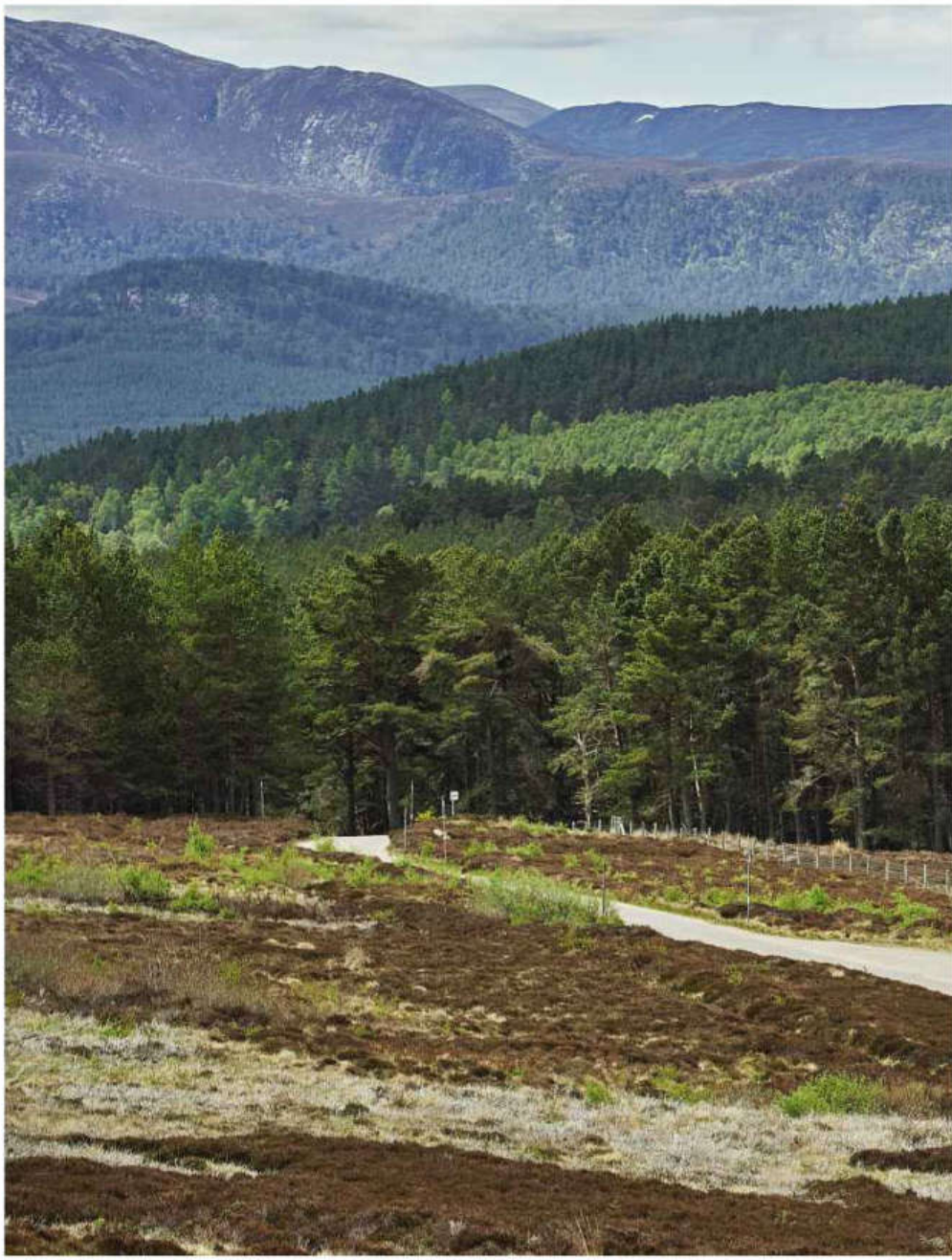
Fat chance

I notice Jon doesn’t have a bottle cage on his bike. This is because he’s currently testing the theory of ‘fat oxidation’ aka glycogen depleted training, which means he regularly goes for four or five hour rides without eating or drinking anything. He is, he explains, training his body to rely on its natural fat reserves for energy, rather than its glycogen stores – or carbs – that need regular replenishing with food and water.

‘Your glycogen will only last for one or two hours depending on the intensity of exercise whereas your fat stores are effectively infinite – even Chris Froome has about 3kg of fat available to burn, or 22,000kcals,’ says Jon, who is a qualified physicist with a PhD in fluid dynamics.

The proof appears to be in the pudding (or lack of), as Jon has won virtually every race and TT he’s entered so far this year, including one 50-mile TT during which he broke the course record without drinking or eating a morsel.

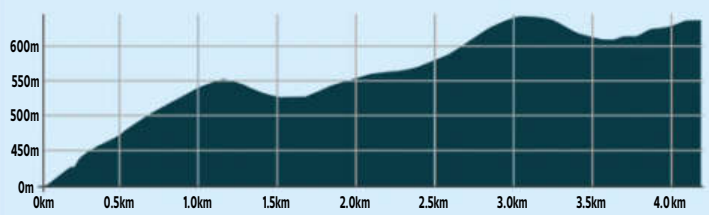
Ahead of us we can see the road rising steeply above the treeline towards the next summit. But first there’s a twisting, technical descent down to Gairnshiel and its famous hump-backed stone bridge. ‘Minibuses can’t get over it without making their passengers get off and walk first,’ says Richard. Once over the bridge, the real climbing starts with a slope that gradually rears up to 20% before slackening off



The Lecht climb

One to tick off the bucket list

The climb to the Lecht Ski Centre is not for the faint-hearted. In *100 Greatest Cycling Climbs*, Simon Warren describes it as ‘a true monster’ and awards it 10/10. Just over 4km long, it can be divided into three sections. The first is the worst, with the road rearing up to a gradient of 20% that doesn’t relent until you reach a layby on your left and the start of the second section. This is where the gradient eases temporarily and you get your first view of the road to the top. ‘It looks like a giant flight of stairs painted on the side of the mountain,’ says Warren. A long, steep ramp starts the final section, where the gradient eases, even going downhill, before a final push to the ski station and a sign that confirms you’re at 2,090 feet.



Above: The climb to Strone takes in 15% slopes before flattening out mercifully

Right: Outside the Last Resort aka the Goodbrand & Ross cafe at the foot of Lecht, trying to negotiate a lift with a vintage car driver





at the wild, desolate plateau of Glas-allt-Choille (pronounced like a bronchial cough) which marks the border between the Dee and Don valleys. By the time we reach its highest point and Jon has been distracted by another snow patch, we've climbed almost 300m in less than 8km. And the toughest climb is still to come.

The last refuge

The Goodbrand and Ross cafe in Corgarff is like an edge-of-the-world frontier post. It's full of desperate-looking characters cradling large cappuccinos and talking in hushed tones about the wilderness outside. They are dressed in tweed Norfolk jackets, leather biker jackets, shiny anoraks or garish Lycra, depending on whether they've arrived by vintage sports car, Harley Davidson motorbike, rusting motorhome or bicycle. Some are glowing with a sense of achievement, others – including us – are pale with trepidation. This is the last refuge before the start of the climb over the Lecht, a mountain whose fearsome reputation stretches back to 1869 when 500 local residents searched in vain for a young servant girl lost in a blizzard (her body lies in a cemetery across the road from us now) and continues today with *100 Greatest Cycling Climbs* awarding it 10/10. As we polish off our coffees, there is a tangible sense of 'Abandon all hope' in the air.

The reason becomes all too apparent as we round the next bend and approach the snow gates. A vertical strip of tarmac appears to have been painted on to a wall. A '20%' warning sign confirms it is not some kind of optical illusion. This is a no-nonsense piece of road shorn of fripperies such as gradient-softening hairpins. We click through the gears until our chains settle on the biggest sprockets, and begin the steady grind up the slope. Jon begins a conversation about our respective wattage – he's testing a new power meter. 'I've just ridden 400 watts for that first minute,' he says, as if he's relaxing at home rather than pedalling up a 20% hill. 'You're doing the same pace as I am, so how heavy are you and I'll tell you what you're putting out.'

I'm finding it difficult to remember how heavy I am, but manage to blurt out '90 kilos'.

'Well the rough rule of thumb is five watts for each kilo difference in body weight. I am 70 kilos, which means you're pumping out an extra 100 – so about 500 watts,' he says, but I can hardly hear him over my pounding heartbeat.

When the slope finally flattens, we get a view of the climb in all its glory. It may not be the longest, steepest or highest, but what makes it one of the most dramatic is the absence of hairpins. The line of asphalt strikes out for the summit without compromise. Barely another



The Lecht climb is over 4km long with a maximum gradient of 20%





vehicle passes us on the way to the top, where the deserted ski lifts swing eerily in the wind.

Our route plunges down towards Tomintoul before we take a right turn and head in to the heart of Scotland's 'Malt Whisky Country'. The road threads through lush, rolling countryside and past a couple of distilleries before we start the descent into the handsome Speyside town of Dufftown. From here it's only a couple of kilometres before we're back in the remote Scottish countryside and starting the long drag up to the Cabrach and my slightly frosty encounter with Wilma at the Grouse Inn.

After my chat with Wilma, we clip in and continue our ride across the empty, rolling vastness of the Cabrach. To our right the tops of the highest Cairngorm peaks are smothered in cloud, while to our left the moorland tumbles away towards the coast and the North Sea.

I wait for Jon to start a conversation about the new chamois pad he's testing, but he stays silent. We're all feeling a little chastened by my encounter at the Grouse Inn, which has been a reminder of how cyclists continue to be treated as second-class citizens, even amid the empty roads and glorious scenery of rural Scotland.

It's an attitude Jon and Richard regularly encounter in their roles as cycling crusaders. The occasional, overgrown ruin of a farmhouse, defiantly preserving the memory of a lost generation, puts everything into perspective.

Trevor Ward is a freelance writer who is treated as a second-class citizen in his own home

How we got there

TRAVEL

The nearest railway station and airport to Ballater are both in Aberdeen, from where it's a straightforward 90-minute drive.

ACCOMMODATION

We stayed at the beautiful Glen Lui Hotel in Ballater where a pine wood chalet – 'recommended for cyclists because they have baths as well as showers,' says owner Susan Bell – costs from £80 single B&B. Or you can pay £160 for a night in their luxury four-poster suite. The hotel also has an award-winning restaurant, where we feasted on a dinner of herb-crusted rack of Deeside lamb followed by dessert of chocolate ganache torte for £30. Full details at glen-lui-hotel.co.uk.

THANKS

Thanks to Richard Lawes of Firetrail Events (firetrailevents.co.uk) and Jon Entwistle (enthdegree.co.uk) for helping us with all the logistical support during our ride, and to Richard's wife, Alex, for driving our photographer. Richard's company organises the annual King of the Mountains sportive, which includes part of the route covered by our UK Ride. The 2016 event will take place on 21st May. Full details at komsportive.co.uk. Thanks also to Steve Smith at Angus Bike Chain, Arbroath, for providing the bike.


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GENTLEMEN'S AGREEMENT

Pro racing has a plethora of unwritten rules that riders either respect or ignore. But do these rules enhance the sport or restrict it?

Words **FELIX LOWE** Illustrations **STEVEN MILLINGTON**

For many years, the sport of cycling was a peculiar mixture of gentlemanly conduct and downright cheating. Riders would respect certain unwritten rules – such as 'no attacking the yellow jersey when he takes a nature break' – while simultaneously ignoring all the ethics of sport by pumping themselves full of performance-enhancing drugs.

These days, while it seems that doping is thankfully on the wane, the unwritten rules of the sport cling on. Take the incident at this year's Tour de France: Vincenzo Nibali, the former Tour champion, was eight minutes down in the standings and looking to salvage his Tour, and seemingly used a Chris Froome mechanical as a springboard for his Stage 19 victory in La Toussuire. Nibali's crime? Controversially attacking on a key climb while the yellow jersey fiddled to fix a problem with his brakes at the side of the road.

'You don't do that to the race leader,' Froome harrumphed of Nibali's 'not sportsmanlike' behaviour, prompting more words to be written about the Italian's supposed disdain for the unwritten rules than about Froome's own inability to master his Pinarello.

Things became even more confused later in the year when Nibali found himself disqualified from the Vuelta a Espana for something that he lamented 'happens in every race'. The Italian took advantage of a 'sticky bottle' – a drag from a team car – to improve his position in the field. The practice is generally accepted when it allows a rider to get back to the pack after they've dropped off the back, but Nibali used the car to drag him *away* from the pack he was in.

If Nibali's transgressions underline anything it's that cycling's tacit moral code is greyer than a British summertime. And while there's clearly no official regulation stipulating when a rider may attack or answer a call of nature, Tinkoff-Saxo directeur sportif Sean Yates believes that 'there needs to be – as in everything – an unwritten code of

Getting a tow from a team car is not uncommon when a rider is trying to catch up after a problem, but Vincenzo Nibali angered his fellow pros when he used a car to pull away from the pack at this year's Vuelta – a move for which he was disqualified





The feed zone should be sacrosanct. 'Attacking there shows a lack of respect for the whole peloton'

conduct where people respect one another'. For Yates, a former yellow jersey-wearer himself, there's a pragmatic element to the rules.

'At the end of the day it's the riders and staff who have to live with each other on the road year in, year out, day in, day out. So it's better that everyone respects each other and doesn't attack when a person has a mechanical or crash. Although in the heat of the moment…' His unfinished sentence hints at a rather large caveat to which we'll return later. But first, let's examine the origins of the unwritten rules – and who better to clarify them than Eurosport's avuncular voice of cycling, Carlton Kirby?

Attacking at the feed zone is bad etiquette – riders believe they should all enjoy the same break – but it has been known. Team Sky did it when they were new on the scene…

Respect the patron

According to Kirby, gentlemanly conduct in cycling dates back to the beginning of the 20th century, when bike races started well before sunrise and the peloton would ride as one before the 'patron' – the father of the race – decided otherwise.

'Although unwritten, this rule was to the benefit of everyone in what was essentially an endurance race,' he says. 'It was a question of survival and if you wanted to be part of the brotherhood you respected the rules.' Charismatic figures such as Jacques Anquetil, Eddy Merckx, Bernard Hinault and Lance Armstrong all took on the mythical mantle of patron, a role assumed today perhaps only by Fabian Cancellara.

If this blend of hierarchy and respect ensured social cohesion within the peloton over time, there are also the issues of hygiene, safety and wellbeing to consider – as exemplified by the delicate balancing act between musettes, manhoods and the mayhem of rolling attacks. 'Once a break has been gone for a while the yellow jersey, a GC rider or an important sprinter comes up and says "time out" and stops for a piss. If you attack then, that's a shit thing. You don't do it,' says IAM Cycling directeur sportif Kjell Carlström.

On top of honouring a rider's basic right of taking a stress-free leak, the feed zone is also sacrosanct. 'Attacking there shows a lack of respect not just for the yellow jersey but the whole peloton,' says MTN-Qhubeka DS Alex Sans Vega. 'If you have lunch in your office you stop work for half an hour – you don't want your boss giving you stuff to do. It's the same in cycling.'

An alternative way of looking at the rules comes from GCN presenter and Eurosport commentator Matt Stephens, who sandwiched 13 years on the police force between careers in the pro peloton and cycling media. Stephens compares the unwritten rules to the 'reasonable person' concept, which has no accepted technical definition in law but touches on our duty to act reasonably, with discretion applied according to context (for example, running a red light en route to hospital).

Team Sky were judged to have acted unreasonably when they arrived

THE UNWRITTEN RULES

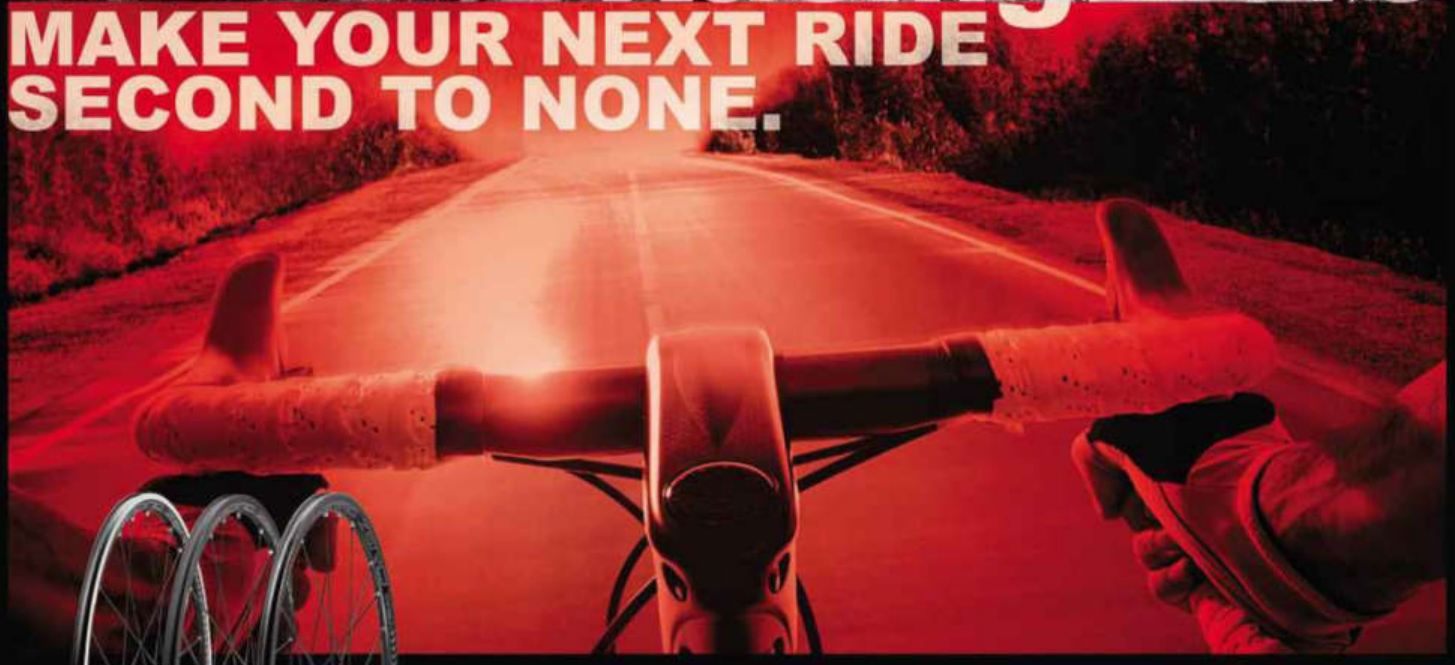
They're not in any rulebook, but they still hold a certain sway in the peloton

- Don't attack the race leader or other main contenders if they have a mechanical, crash or puncture.
- Don't attack in the feed zone or during a comfort break.
- Don't attack the yellow jersey on the Tour's final stage.
- Riders in a break must take turns setting the pace rather than sitting in the draft.
- Teams must buy the right to fight by pulling on the front of the peloton if they want to contest the final sprint.
- Race commissaires and rivals will turn a blind eye to a rider getting a limited amount of help from drafting the team car or taking a 'sticky bottle' if it is used to get the rider back to the pack after a crash or a mechanical.
- Race leaders or the 'patron' can call a neutralisation or go-slow if race conditions are considered dangerous.



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'A mechanical is like having a bad night's sleep. If your kit fails – hard luck. If somebody drops a baton in athletics you don't get to do it again'

on the scene with their big budget, bigger bus and apparent aversion to the old-school ways. Attacking at a feed one day resulted in the peloton upping the tempo when a Sky rider stopped for a pee. Such revenge tactics are not uncommon – even if Yates, Sky's DS at the time, doesn't exactly agree: 'If someone goes and shoots your grandmother, are you going to retaliate and shoot theirs? No, you're not. Then it just starts this vicious circle, like gang warfare, and you end up just shooting each other. It's not conducive to a good living, is it?'

Nevertheless a mob rule mentality – structured by the unwritten rules – does grip the peloton. Sean Kelly remembers his PDM team being ordered by their DS to attack in the feed zone during a blustery stage to Marseille in the 1990 Tour in a move that momentarily split the pack. 'We got a lot of abuse from other riders and teams,' Kelly tells *Cyclist*. 'They remember those things and you're always worried as a rider that you're going to get paid back some time.'

When retribution comes, the rules go out the window. 'Breaking the rules opens the situation for somebody else to break the rules another time – and not just in any place,' Kelly says. 'It will be when you're race leader and you maybe have a mechanical and the pace is fast. They don't feel like they're breaking the rules because it's just payback time.'

Yet when Nibali punctured at the foot of Alpe d'Huez a day after his victory at La Toussuire, the fact that no one waited was not so much payback as coincidental karma. The race was on – just as it was when Kelly's Kas team distanced Stephen Roche on the final stage of Paris-Nice in 1987 after the latter punctured on the Col de Vence 20km from the finish. 'We upped the pace but it wasn't an attack because we had been riding tempo all day,' says Kelly. 'He lost and I won so of course he wasn't happy. But you can't just stop the race.'

Yellow peril

The point at which it is acceptable to attack the yellow jersey is the key question that drives much of the current narrative surrounding the unwritten rules. Tradition dictates that crashes, mechanicals and punctures should all be followed by a gentlemanly act of good will – the kind that earned Jan Ullrich a 'World Connection Award' when he slowed for Lance Armstrong after the American fell on Luz Ardiden in 2003.

For Kirby, punctures are merely 'part of the game'. 'Yellow jersey has a flat? Off you go. You have good fortune and bad fortune – everyone has their own percentage and where do you draw the line?' Sans Vega agrees: 'When the yellow jersey crashes you must wait. But punctures are a personal thing. It can be the tyres your team are using or the pressure. And there are some riders who puncture more than others because they simply don't look at the road.'

Mechanicals are a fierce debating point, too. 'It's time to do away with these tacit agreements and codes of etiquette whereby equipment is considered sacred ground as to whether you can attack or not,' the journalist Daniel Friebe told the *Telegraph Cycling Podcast* after the Nibali incident during the Tour. The general consensus was that Nibali had already prepared the terrain before Froome had stopped. Throw in the context of his lowly place on the standings and Nibali arguably had no reason not to attack.



DOING THE DECENT THING

At the Tour de France, some follow the rules, some don't...

Tour de France 2003, Stage 15: Jan Ullrich and Tyler Hamilton slow down after Lance Armstrong hits the deck when his handlebar hooks a young fan's bag on the climb to Luz Ardiden 10km from the finish. Armstrong recovers to win the stage – and the Tour – while Ullrich later receives a World Peace Prize from Mikhail Gorbachev.

Tour de France 2010, Stage 2: After both Schleck brothers crash on a wet, oily descent in Belgium, Saxo Bank teammate Fabian Cancellara uses his sway as both the yellow jersey and patron of the peloton to enforce a go-slow. Lone escapee Sylvain Chavanel takes the win – and the *maillot jaune* – while the rest of the peloton trickles into Spa.

Tour de France 2010, Stage 15: Alberto Contador attacks as race leader Andy Schleck drops his chain on the Port de Balès climb. The Spaniard crosses the line 39 seconds clear of his rival – the same gap that will separate them in Paris one week later. Schleck has the last laugh when Contador is retrospectively disqualified for doping.

Tour de France 2015, Stage 19: Vincenzo Nibali attacks near the summit of the Col de la Croix de Fer, just as yellow jersey Chris Froome stops to remove a stone from his brake. Nibali goes on to win the stage in La Toussuire – the same mountain where Froome once famously attacked his own teammate Bradley Wiggins in yellow.



'He had every right to do so,' agrees Kirby. 'To my mind a mechanical is like having a bad night's sleep. If your kit fails – hard luck. If somebody drops a baton on a relay in athletics you don't get to do it again. The teams have different levels of technical capability and it seems off that it's the only equality that's demanded when that's really an odd thing to quantify.' Kirby even feels attacking on a mechanical is a welcome 'equaliser' in the sport.

Indeed, in an age where so much emphasis is put on marginal gains and kit – to the extent that mechanics are poached from rival teams – the disparity between the rich and poor teams is large enough without riders being able to hide behind kit issues dressed up as fair play. 'Froome could have a hundred mechanicals between here and Paris if he's that desperate not to get attacked,' Friebe mused.

Of course, there was much more at stake on the Port de Balès climb

Mechanicals are a grey area when it comes to the unwritten rules. A bike failure may simply be down to poor work by the team – or could even be a ploy by a desperate rider to avoid being attacked

in 2010 when Alberto Contador famously rode away from Andy Schleck en route to prising the yellow jersey from his spindly shoulders in an episode that became quickly tagged 'Chaingate'. The Spaniard was roundly chastised for his unsporting actions, although many pointed out that he had already placed his attack before Schleck's mechanical. 'I would also go a little further and maybe say it was Schleck's own fault he dropped his chain because there



What's better: being the moral victor or standing atop the podium, calculated and cold-blooded?

was no need to shift down at the time,' says Carlström. 'Here the rules are so ambiguous and so dependent upon a perceived context that they're almost worthless,' says Stephens.

Like Froome, Schleck was vexed, telling reporters that night, 'In the same situation I would not have taken advantage.' It was perhaps a bit rich of him to take the moral high ground when, less than two weeks earlier, a Cancellara-chauffeured Schleck distanced his GC rivals on the cobbles after his own brother Frank crashed and caused a split in the peloton. And one day earlier, Cancellara – in yellow after his victory in the prologue – had used his unwritten status as patron to enforce a go-slow in the peloton after both Schlecks hit the deck on a slippery descent to Spa.

'It's nonsense – tactical negotiations dressed up as doing the gentlemanly thing,' claims Kirby. 'Everyone pulls the gentleman's conduct card when it suits them and even Froome's not adverse to doing it.' The obvious problem in playing this game is that while the authoritative Cancellara commands respect, the likes of Froome and Schleck don't share the same clout among their peers. This may have something to do with a general lack of respect that Carlström feels permeates both the peloton and all walks of life today – something he attributes to a lack of education.

Romance or reinvigoration

It's this gradual cultural erosion and general absence of leadership in cycling – stemming from teams having less structure and offering more opportunities to riders beyond the designated leader – that Stephens feels has made the unwritten rules 'increasingly diluted and less relevant. They have been eroded because of the lack of hierarchy'.

In an era where breaking an unwritten rule could be the difference between losing a race or winning and securing a contract next season, is it any surprise these traditions are slowly fading? Give most riders a sniff of victory and the survival instinct kicks in, often giving way to a win-at-all-costs mentality. Why take a pull for the sake of some pointless guidelines if it makes you look tactically naïve? What's better: being the moral victor or standing atop the podium, calculated and cold-blooded? In short, being reasonable and generous is irrelevant when a result is at stake. As Sans Vega says, the rules are all well and good, but 'if there's a small option that plays in favour of your team, you will take that option'.

So, for how much longer will the unwritten rules exist – especially if, as Stephens ventures, they're already practically a 'meaningless, romanticised concept – an anachronism really'? Kelly feels it's a 'discussion that will go on for as long as we live', but senses that the more the rules are broken and re-broken via the ongoing cycle of payback they will eventually 'go out of the window'. It's a stance the Irishman's Eurosport co-commentator shares. 'The rules are there for the convenience of the riders and when it's inconvenient for the majority then that will be the end of the rules,' says Kirby.

One thing's for certain – they won't just disappear overnight. They're too ingrained in the fabric of cycling, but the cultural shift in the sport makes these romantic vestiges more and more redundant. Stephens concludes, 'By their nature they're unenforceable and all you stand to lose is possibly the respect of an increasingly diminishing amount of people.' ✱

Felix Lowe is the undisputed patron of cycling journalists, although for how much longer is uncertain



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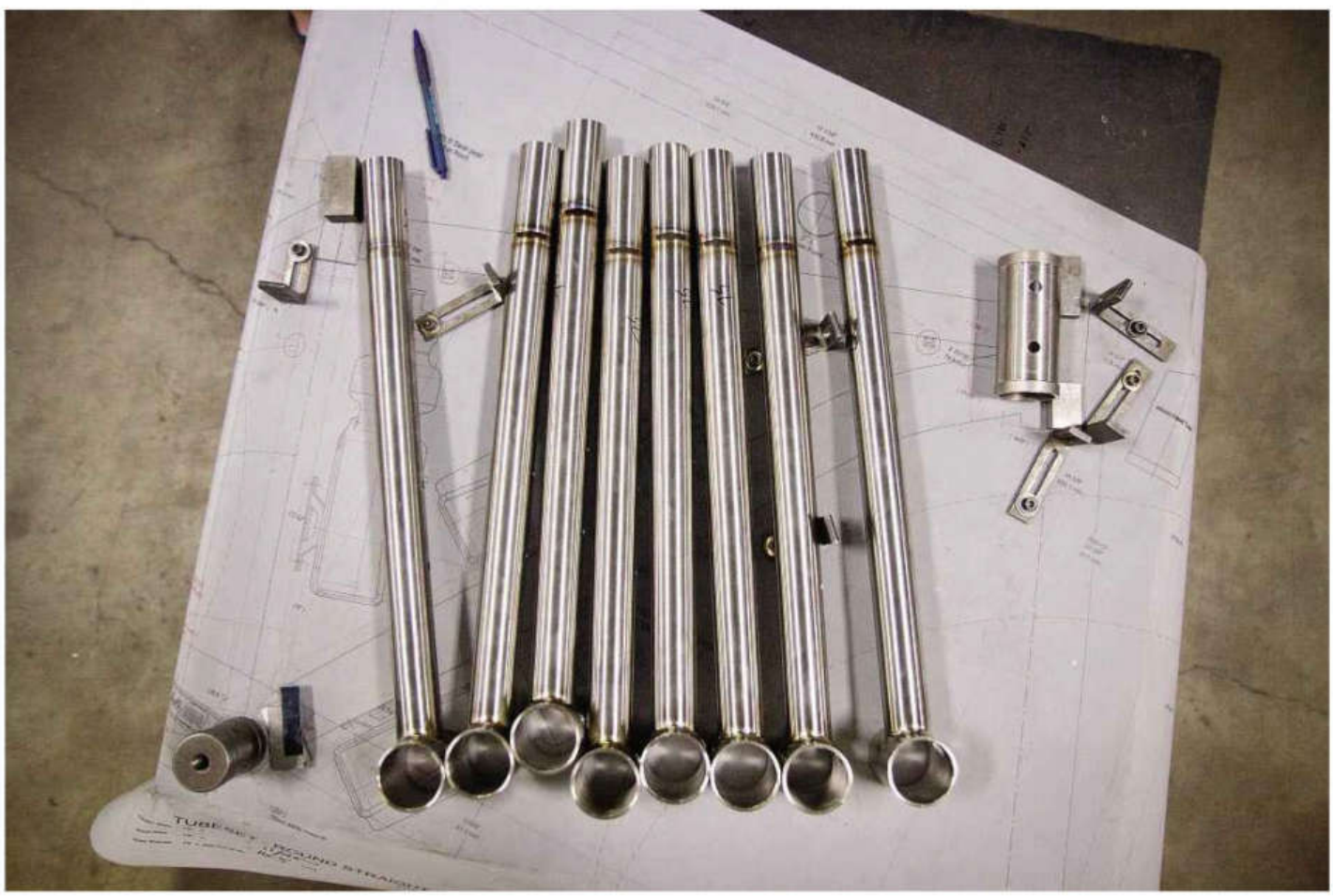
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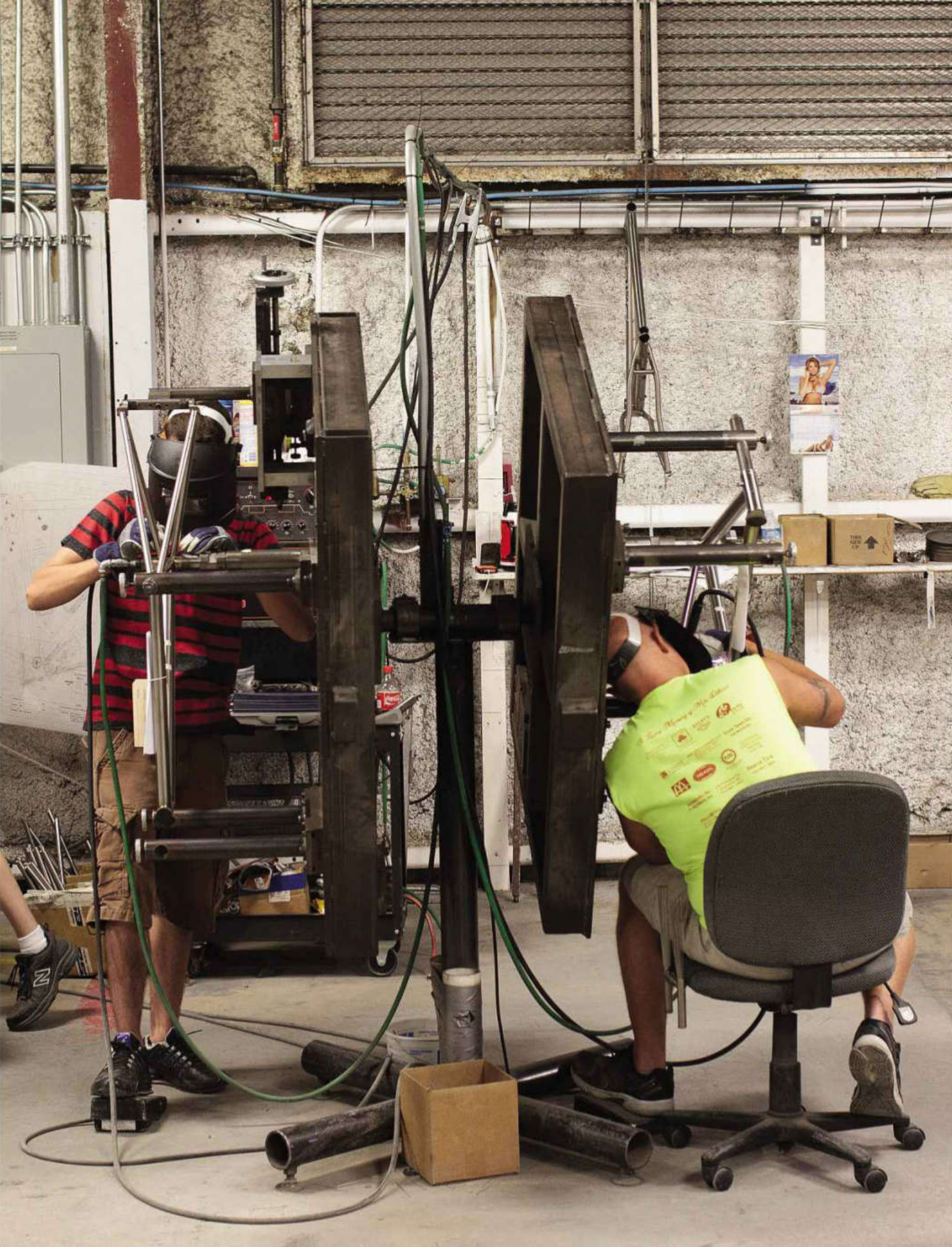
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Living the Ti life

Lynskey has been working with titanium for three generations and, if the current interest in its bikes is anything to go by, it won't stop there. Cyclist visits the US factory to see what makes those welding guns tick

Words **JAMES SPENDER** Photography **ROB MILTON**











'You don't order Pepsi round here unless y'all want to get chucked out,' says Mark Lynskey in a soft Southern drawl. 'This town was built on old Coke money. In fact the world's first Coca-Cola bottling plant was opened here in 1899. We used to be heavily industrialised here, but now it's mostly tourism that brings the trade.'

'Here' is Chattanooga, and although that loss of manufacturing means it's now rows of neat houses, gentrified barbeque shacks and boutique coffee shops that radiate away from the Tennessee River, there is still at least one hive of industry: building number 3911, just off Highway 317 down a little cul-de-sac called Volunteer Drive. From its beige, corrugated exterior there's little indication of what's going on inside, the only clue is a familiar looking roof rack attached to a monstrous Ford truck out front.

Before we're guided to the entrance, Mark takes us on a detour to a slatted hut within a fenced enclosure adjacent to the main building. 'I just got to feed Grayson,' he says.

It's a surreal moment as the remnants of last night's barbeque ribs are chucked over the fence, and out of the hut (which has an air-conditioning unit and satellite dish) bounds a giant, tan-coloured wolf. 'We take him out for walks and things. He's technically wild but really very tame,' says Mark, adding, 'Aren't you boy?' for reassuring measure. The Lynskey family, it seems, do things differently, and that includes the way they make their bikes.

At home with the Lynskeys

Although the Lynskey name has only adorned the down tubes of high-end titanium frames since 2006, the family's history in that most coveted of bicycle metals stretches much further back. In fact, 'dynasty' might be a better word to describe the family behind the company.

Evolving out of a machine shop run by their late father, Bill, Lynskey is now owned and operated by siblings Mark (sales, marketing, design),

GOOD THINGS DON'T COME EASY

Titanium has oft been cited as a difficult material to work with, but is that reputation justified?

'Apart from the bike industry no one really needs to weld tubes as thin as we do, down to 0.5mm wall-thicknesses,' says Mark Lynskey. 'One of the main tubes we use, 3/2.5 [a titanium alloy with 3% aluminium and 2.5% vanadium], was created to be the hydraulic tubing on aircraft, so all they're doing there is bending it and putting on a hydraulic fitting – there's no welding. As a result there's very little collective wisdom about how to weld titanium.

'As a material it's weird in that it's very impervious to corrosion up to about 950°F (510°C), but above that it switches. You can't generally see contamination in a weld, but you'll know about it when it cracks in five years' time. Even if your fingerprints are too oily that can compromise a weld.

'Remember in science class the model of an atom – protons and neutrons with little electrons spinning around them? Every electron wants to attach itself to something. The outermost electron of ti is free, and nothing will attach to it until you hit 950°F. After that it wants to bond with hydrogen, which is everywhere, so you have to make damn sure there's none present when you're welding. To get around this we pump argon gas onto the weld during fabrication.

'The big challenge on a bike is that you're not going to hide those welds – they have to look good as well as be sound. Our welders have to produce neat, uniform and structurally sound welds in a single pass. I can look at pretty much any titanium frame and tell you who welded it.'



'When you've got De Rosa, Tommasini, Merckx, all these cycling gurus coming to you, you can really learn about bikes'

David (design, plant manager), Chris (engineer and computer programming), Tim (finishing) and Theresa (shipping manager), together with family matriarch Ruby (financial manager). Alongside Ruby in the office is Mark's daughter, Stephanie (marketing manager), while out on the shop floor can be found Chris's wife, Toni (lead welder), Mark's son Liam (today on sandblasting duties) and Liam's great uncle, Bill (technician).

'I can't even tell you how long Uncle Bill's been with us – since back before we were born, probably,' says Mark, nodding towards an elderly gentleman in a crisp white work shirt who's fastidiously cutting sheets of titanium. 'He's semi-retired now, but he'd still work five days a week if we let him.'

Bill, it turns out, has seen a thing or two – from the brand's early machine shop days, to its transition from Litespeed to Lynskey, to its current throughput of $50,000 (£33,000) worth of titanium alloy every month. As we tour the cavernous factory, the humming bass of heavy machinery punctuated by the trebly tick-tick-ticking of welding guns, Mark begins to unravel the story behind the brand.

'My brother David was a runner at college, but he had knee troubles so had to quit. Instead he took up cycling, and before long he was competing at regional level. That must have been 1984 or '85. Back then our father was running a company called Southeast Associated Machine, doing industrial contract work, so it wasn't long before

Above: The finishing department in full flow. Lynskey even has its own bubble-wrap machine (back left)

Top left: The plant has machines dating back to the 1940s, and if something needs fixing or building it's almost always done in-house, such as this Lynskey 'frame tree' (centre left)

David thought, "Heck, making things is what we do – I'm going to make my own bike. We've got some titanium over here in the rack. It'll be light, it'll be strong, that ought to be pretty neat." So he bought this book about how to build frames – I think he still has it – and I clearly remember standing out in the shop and going through it, saying, "OK, so they call that a chainstay, that makes sense because it's near the chain. That one's a seatstay then." That's truly the level we were figuring things out at. David reckoned on a 60cm size frame, and we got it built, started switching over parts from his old bike and then very quickly we learned what toe-overlap was. It was probably the only 60cm bike in the world with four inches of overlap!'

However, despite 'not having got the whole geometry thing perfect yet', David's bike was a hit among his friends, who soon began pestering him to make frames for them.

'It was a hobby at first, until one day the owner of the business next door came in to check on some work we were doing for him and he brought this friend of his who was really into triathlon. He spies David's bike – you know how tri geeks are just magnetised to equipment? So he says, "What's this?" and we explain it to him. "Do you sell 'em?" he says. "Well, we could I guess, but do you know how expensive that would be? Would anyone buy them?" He was like, "Yeah, you really need to do this!" It turned out he was one of the people who started *Triathlete* magazine, and he helped us get a little booth at this bike show in Long Beach, which would later move to Vegas and become Interbike. David built a couple of frames to show there, and that really kicked us off.'

Those early bikes debuted to the industry in 1986 under the name Litespeed, and by 1989 an addition was built to the Southeast workshop just to make bikes, with Litespeed hiring its first employee, Eric Barnes. 'Eric's another one who's still with us today – hey Eric?' says Mark, jovially slapping Eric on the back as we pass through the tube mitring stations, where technicians are busily mitring and lining up the pre-cut tubesets on top of frame-sized paper blueprints.

Right: No self-respecting US workshop is complete without the good ol' Stars 'n' Stripes

Below: One of the welders' customised desk chairs, complete with bottle cage and double holster of welding feeds



'The last bike Robin Williams ordered from us, he called up pretending to be Mrs Doubtfire'

Learning fast

The early 1990s saw an explosion in the popularity of titanium, yet in those early days Litespeed had little competition. In fact what competition there was worked in Litespeed's favour, with the only other big name in titanium at that point, Massachusetts-based Merlin Bicycles, passing on contract work from other bike brands to Litespeed.

'We'd spent our lives making stuff for other people, so it was only natural. Our first contract was with Marin, but by 1993 we were making bikes for 21 different brands, and by 1996 we'd stepped away from industrial work to do bikes full-time,' says Mark. 'It was during this period that we really started to understand bikes. When you've got Ugo De Rosa, Irio Tommasini, Eddy Merckx, all these cycling gurus coming to you, and you're good listeners, you can really learn what makes a bike tick.'

Evidently the Lynskeys were very good listeners indeed. Their bikes quickly gained a good reputation, not least as rebranded machines raced by a number of professionals in the mid-1990s, including a certain Mr Armstrong, who pedalled a Litespeed-built Eddy Merckx bicycle to victory at the 1993 World Road Race Championships.

'It's not like we'd hang out and have a beer, but he'd come in with Steve Hed [of Hed Wheels], who he worked with very closely at the time, and we'd chat for 45 minutes about technical issues. We did bikes for him at Trek too.'

Offers to buy Litespeed came thick and fast. At first there was little impetus to sell, but all that changed when a gentleman by the name of Leon Hirsch appeared on the scene.

'Leon had created US Surgical, a company that had pioneered surgical staples and scope technology. He sold up [reputedly for $1.4 billion] and started an investment company with his business associates, and we were their first investment. He tabled this offer that made us go, "Er, sure, here are the keys!" They needed someone to run the company so I stayed, and over the next five years we bought five other companies, including Merlin Bicycles.' Litespeed continued to do good business, however Mark resigned from the company in June 2005.

'It was this global company, and I found I was spending half my life in the sky, and that was taking me away from what I loved doing – making bicycles – so I quit.

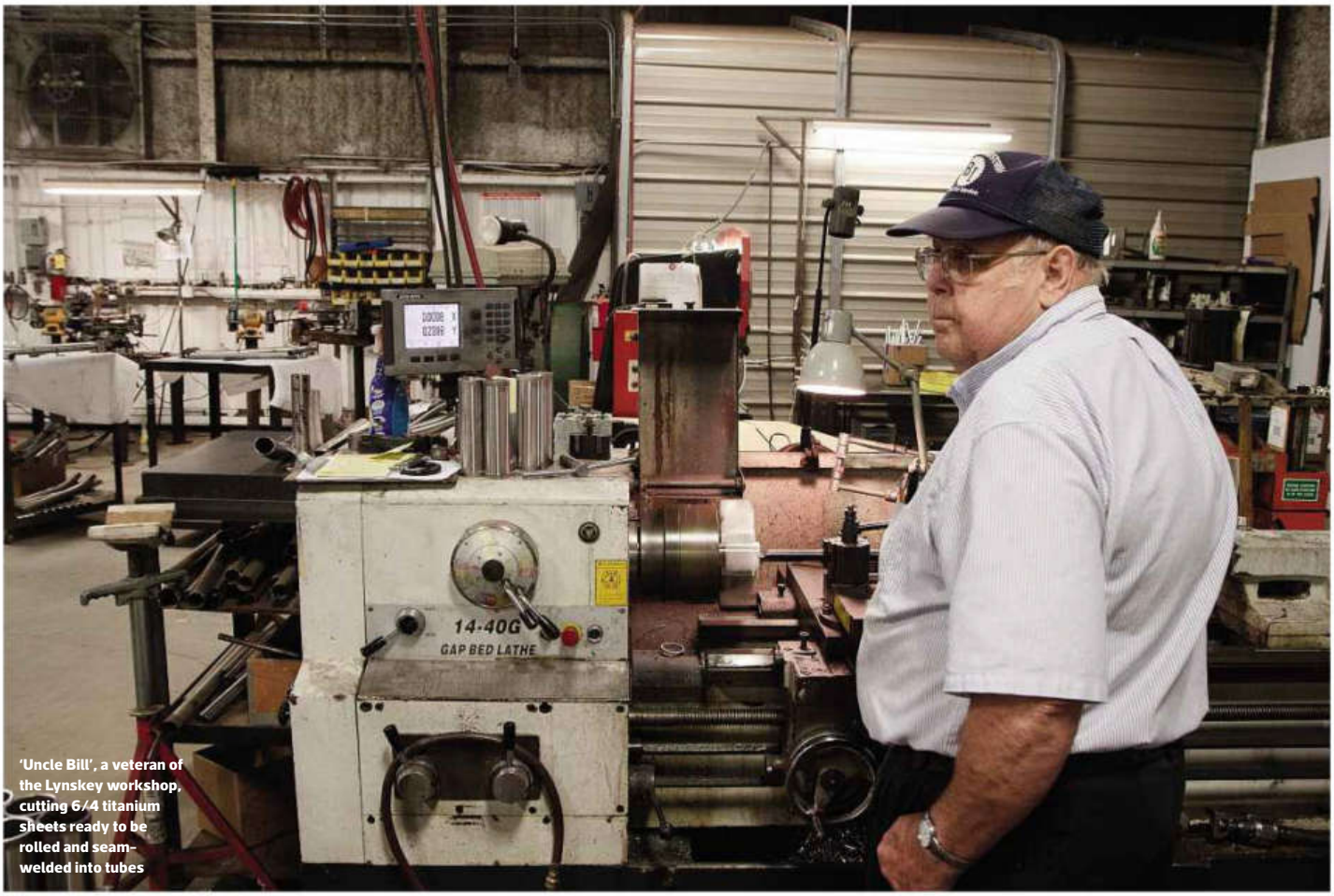
'By September my mom Ruby's on the phone saying what are you going to do? And unbeknownst to me she's also on the phone to my brother David saying you've been sitting on your butt for too long! We sat down at Thanksgiving in November and had a talk, and by January 2006 we had leased a building and started buying manufacturing equipment. The initial plan was just to make custom titanium frames, but after a while the demand from dealers for stock models was so high we started doing those too. And that's where we're up to today as Lynskey Performance Bicycles.'

Tall and funny lookin'

The Lynskey portfolio is now burgeoning and includes road bikes, full-suspension downhill bikes, breakaway frames, tandems and children's tricycles. Today the factory turns out around 140 bikes per week, closing only for national holidays, and if you come to Lynskey with a suggestion for a one-off bike it will do its best to accommodate you.

'You have a lot of people that get into the bike business because they like bikes, but do they really know how to make them effectively? What





'Uncle Bill', a veteran of the Lynskey workshop, cutting 6/4 titanium sheets ready to be rolled and seam-welded into tubes

sets us apart is that we started out as manufacturers in the chemical, industrial, military and aerospace industries, and then we got into bikes, so we know the building process, the limitations and the material inside out. That really helps when you get NBA players coming to you asking for 72cm frames. One guy wanted inch-and-a-half tubes, so we had to explain that you just can't do that – we don't want a bike out there that rides like a noodle. We had this little guy working for us at the time and that bike was so big he could nearly step through the middle of it without stooping.'

It's not just NBA players who have sought out Lynskey either. Perhaps its most famous customer was the late comedian Robin Williams.

'He'd get a bike from us every two or three years, and it was hilarious. He'd call up and start using one of his characters' voices to make us guess who it was. I think the very last one he ordered from us he actually called up my daughter Stephanie pretending to be Mrs Doubtfire.'

To validate this, Mark points out a picture in the company showroom of a smiling Robin Williams with his new Lynskey, along with a host of other newspaper clippings about bicycles built for Tour riders, dignitaries and Olympians. Arguably most telling of all is a framed, scrawled picture entitled 'Pencil Sharpner' (sic), which shows a pile of pencils going through a fan operated chipping machine and coming out in recycled chips, all under the watchful gaze of a cartoon mouse.

'Oh, that,' chuckles Mark. 'I was in second grade at a school where all the teachers were nuns. I drew that at the back of class one day and one of the nuns caught me, so she made me mail the drawing home with a letter saying "I did this instead of my arithmetic". Why is there a mouse in the corner? He's just checking things out, making sure everything's running OK.'

At the moment it seems things are running rather more than OK for Lynskey, but having seen the operation and heard the stories, that's no accident. These people really do live and breathe manufacturing titanium, and the bicycle industry should consider itself lucky the Lynskeys chose it in which to ply their trade. ✱

James Spender is staff writer and chief Mrs Doubtfire impersonator at Cyclist



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Tour diaries...
THE MECHANIC

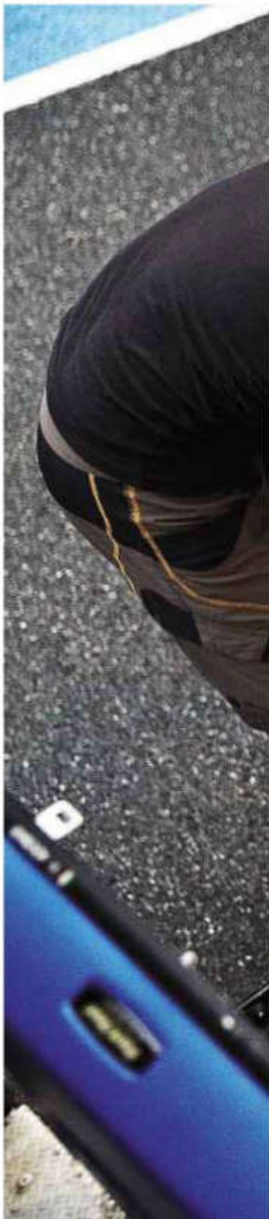


On Tuesday 30th June 2015, Trek launched the Madone 9, a bike so aerodynamically advanced that the American bike giants proclaim it saves around two minutes per hour. To Trek's marketing team, the Madone 'is the ultimate fusion of power, aerodynamics, ride quality and integration'. To Mauro Abobati, Italian mechanic at Trek Factory Racing, it's a pain in the neck.

'Someone from Trek came over to show us how to maintain the Madone 9,' Abobati tells us as we make our way to the start of Stage 17 of this year's Tour de France, a 161km slog from Digne-les-Bains to Pra Loup.

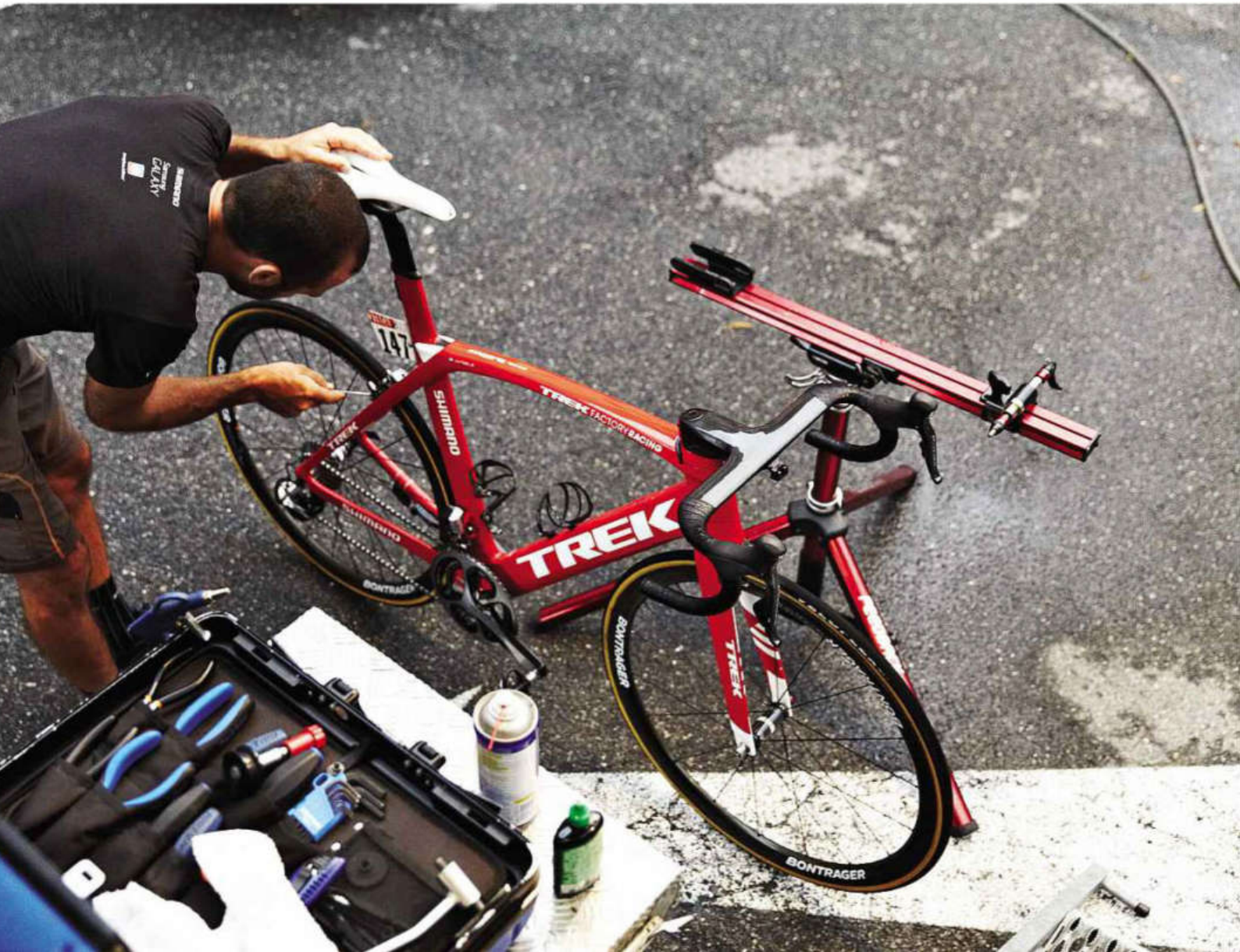
'It's almost like a time-trial frame and currently takes about twice as long to assemble as normal because all the cable routing is inside. It's technically more challenging to the mechanic, but it *is* a beautiful bike.'

Abobati is one of four Trek mechanics at this year's Tour. These unsung heroes of the peloton remain in the shadows, unlike their Formula One counterparts who enjoy their minute of fame (well, three seconds) every time Hamilton and Raikkonen pit for a wheel change. Bike mechanics rarely receive praise, instead attracting headlines only if something goes wrong. Think of Andy Schleck losing the yellow jersey to Alberto Contador after his chain

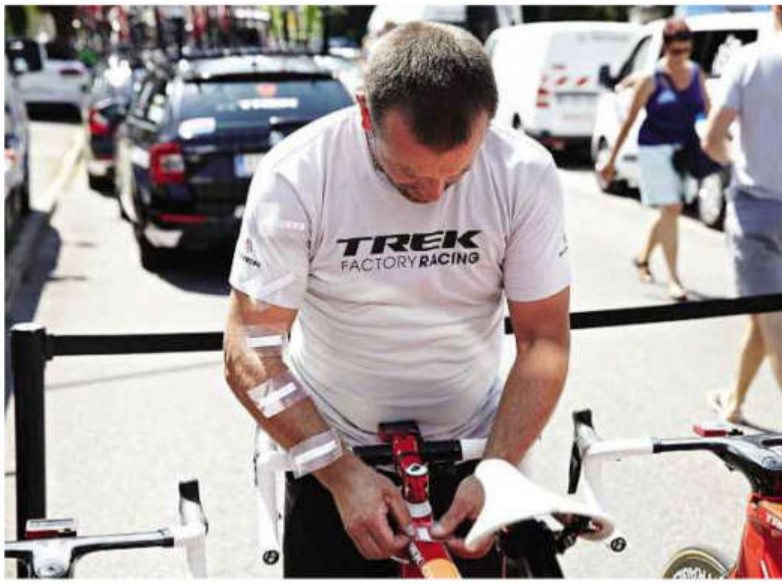


In part two of *Cyclist*'s look behind the scenes of a pro team at the Tour de France, we meet the man whose cool head and allen key helped Trek Factory Racing reach Paris

Words **JAMES WITTS** Photography **JUAN TRUJILLO ANDRADES**







Previous page: Trek's mascot, Herman the sheep, keeps a beady eye on everything

This page: A mechanic's work is never done

slipped off on an ascent of the Port de Balès during the 2010 Tour de France; or David Millar throwing his bike over the barrier during Stage 5 of the 2008 Giro d'Italia when his chain snapped just as he was attacking for the win with 1km to go.

Fortunately, mechanical incidents in the Grand Tours are remarkably rare which, considering that each rider racks up between 12,000km and 14,000km of racing each season on top of 15,000km to 20,000km of training rides, warrants a *chapeau* to the men with the wrenches.

With a general's calm authority, he plucks out the correct tool to return the gears to their former glory

Covering plenty of ground

Trek has 26 riders on their payroll (plus two stagiaires), which means more than 702,000km is covered by the flotilla of Trek bikes.

By the end of the Tour, Abobati and his fellow mechanics will have played an essential part in seven of Trek Factory Racing's nine starters arriving safely in Paris. Dutch rider Bauke Mollema, who moved from Belkin at the end of 2014, will finish seventh, 15mins 14secs behind Chris Froome. Two riders won't make it to the Champs Élysées – Luxemburg's Laurent Didier, a gastro-intestinal issue leading to a DNS come Stage 17, and Fabian Cancellara, who withdrew after Stage 3 due to a horrific crash that fractured two vertebrae. 'We went to bed at midnight that day,' says Abobati. 'We had to change his components and work on the frame but, as it transpired, he didn't start.'

The next day and every day of the Tour begins with a 7am alarm call. Two mechanics accompany two directeurs sportif's cars – one in each car – while the other two either stay at the current hotel (if the race is returning to the same place) or head to the next stopover. Abobati's schedule depends on which role he's allocated to.

'On a day like today [Stage 17, where Abobati is in the car with DS Alain Gallopin], I'll have breakfast and then, around 45 minutes before we leave for the start, I'll pump up the tyres, put the bikes on the car and attach the spare wheels. If all goes well, the rest of the day should be quiet. If we're working while the ●



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The mechanics who've been at the hotel all day are responsible for jetwashing off the detritus accumulated from another hard day in the saddle



action is unfolding, clearly there's been some kind of incident.'

Two days later we're on the Alpine queen stage from Saint-Jean-de-Maurienne to La Toussuire-Les Sybelles, won by Italian Vincenzo Nibali, and there's an incident. Mollema is involved in a crash. It's nothing serious, he's given a replacement bike by the lead DS car and rolls on. There's a crackling of the radio in Abobati's car and a stream of barely intelligible instructions.

The signal has been given to speed up and reclaim Mollema's Émonda, which has been left by the side of the road. Until now, Abobati has been a quiet passenger in the back, but this is his call to arms. He leans over the back seat to the boot, retrieves his toolkit and, as Gallopin pulls up to the lonesome red steed, Abobati glides over and assesses the damage.

I don't interrupt, suspecting that interviewing a mechanic in the heat of battle would receive the same response as asking Lance Armstrong circa 2000 if I could grab a pint of milk from his fridge. Why would I interrupt? For the next four minutes Abobati morphs into a mechanic's version of a prima ballerina at the Royal Opera House. The Italian remains unruffled as he identifies that the alignment of the Shimano Di2 rear mech has been thrown out by the crash. Unfurling his soft-pack toolkit with a general's calm authority, he plucks out the correct tool to rapidly return the gears to their former glory.

Observation turns to introspection as my mind wanders to countless times I've floundered at the roadside for 15 minutes or more, apoplectic with rage as I wrestle with a clincher tyre that refuses to re-clinch.

'With experience you control your nerves,' says Abobati. 'Sometimes a change might take longer if the rider hasn't put the chain down to the right gear. And the front wheel changes take a little longer these days because the UCI banned filing off the end of the dropouts [the curved safety tabs], which some teams used to do for a quicker replacement.'

How many bikes on the roof?

Mollema's bike is returned to the Skoda's roof and placed at the helm of the Tour caste system. Each car can take up to nine bikes, though only four are clamped into place with wheels fitted. 'These are on the outside and are for the most important riders as they're easily taken off. That will always be the GC rider plus whoever's playing a pivotal role that day. Space restriction means the five in the middle are attached via the front dropouts.'

Several miles later I peer over the back seat into the boot and see a pile of Bontrager wheels. It's tempting to dive in with more questions, but I don't dare wake a snoozing Abobati.







As well as his moment of repairing fame, he's spent much of the stage passing drinks bottles from the boot-based fridge to Gallopin, who then passes them on to the Trek riders through the car window. It's the same with the rice cakes, prepared and wrapped in foil by the soigneurs.

After more than two weeks of racing everyone's tired, and as many of the support staff's days begin early and end late, it seems only fair that Abobati should enjoy a short siesta while there's nothing much else to do.

Abobati wakes from his brief slumber to pass another bottle. It's done silently as if he's on auto-pilot

'Mauro! Mauro!' shouts Gallopin from the front. Abobati awakes from his brief slumber to pass another bottle. It's done quickly and silently, as if on auto-pilot. Abobati smiles. This is life on the Tour away from the podium girls and packed press conferences. And it's the kind of life Abobati has enjoyed for many years.

'I worked at a bike shop in my home town of Bergamo from the age of 15,' he says. 'Steel used to be the main material, then aluminium and finally carbon. I enjoyed it, but 12 seasons ago I was asked if I'd like to be a mechanic for Saunier Duval who were also based in Bergamo. I spent five years with them and spent a similar period with Katusha before moving to Trek a few years ago.'

'Why move?' I ask. 'I wanted some fresh air, a new scene,' Abobati replies, though whichever team he's worked for there's one feature of the job that remains exactly the same – time away from home. 'I'm away for 190 days each year,' he says, which is around 50 more than the team's chef, Kim Rokkjaer, whom we followed last issue. 'That's the hardest part because I have a wife and two boys. But I couldn't go back to a nine-to-five. It wouldn't offer me this freedom.'

Labour of love

I'm pondering how much freedom the Tour offers a mechanic who'll be cooped up in a car for hours on end, but the romantic in Abobati soon answers my thoughts. 'You can't do this job unless you love cycling. Look at the facts. I'm involved in races like this and the Belgian Classics, which are my favourites, and I work with great people like Fabian. I choose the wheels they use, so I also play an important role for the rider and team.'

Abobati's second home is the Trek truck, which houses more than 50 wheels, plus road and time-trial

QUICK Q&A

Abobati's swift tips for coping with the Tour

What's your best piece of advice for anyone who's about to ride a big event?
Being a mechanic, this is an easy one – check your bike into your local bike shop for a once-over in the two weeks before your race. They'll iron out any mechanical problems that could crop up out of the blue and spoil your big day.

What's your best piece of advice for anyone visiting the Tour de France?
I'd implore everyone to see a mountain stage. The drama and beauty you'll experience is on a different scale.

What's the weirdest thing that's ever happened to you while working at the Tour?
Strange things happen to the riders and support staff every single day. Having Herman the sheep, [Trek's Tour mascot, see p122] watching you while you work at the truck is pretty odd.





Every rider's bike gets the same treatment, although Cancellara's bike gets the special attention of the head mechanic

bikes as well as the specially adapted Domane that was used for this year's cobbled stages. An extra-long wheelbase, cushioning system in the seat tube and extra handlebar tape complemented the reduced tyre pressure to cope with the harsh terrain. 'Normally the riders' wheels are around 8-8.5 bars [120psi approx]. Julian Arredondo might run a touch lower because he's light [61kg]; Fabian a bit more because he's bigger [85kg]. When it came to the pavé, we used 28mm tyres and dropped pressure to 4.5-6 bars [around 70psi].

'There are extended periods of boredom, but compare this life to a factory job. We are privileged'

'You can safely run lower pressure with a slightly bigger tyre as there's less chance of a having pinch flat.'

Once the stage is finished, it's back to the team hotel. When Abobati is on race duty he'll spend much of the time assessing the riders' bikes, ensuring gears are aligned and power meters are removed for data assessment by the sports scientists. The mechanics who've been at the hotel all day are primarily responsible for jetwashing off the detritus accumulated from another hard day in the saddle.

By this stage of the Tour, choreography is seamless, each mechanic silently performing their duties against the backdrop of humming generators driving those gushing handheld jetwashes, punctuated by the occasional joke to raise the flagging energy levels.

Each to his own

The mechanics work on every rider's bike, though Cancellara's status means his bikes are the sole responsibility of German mechanic Roger Theel, a man for whom outsiders are 'greeted' with a stern look. Abobati assures us that, within the mechanic's inner sanctuary, he's much friendlier than he appears – and there's nothing to be scared of.

'There's great camaraderie between mechanics and all the team. There are long days with extended periods of potential boredom, but compare this life to a standard factory job? Just forget about it. There's no contest – we are the privileged ones.'

James Witts is a freelance writer whose toolbox contains a penknife and a half-used roll of gaffer tape



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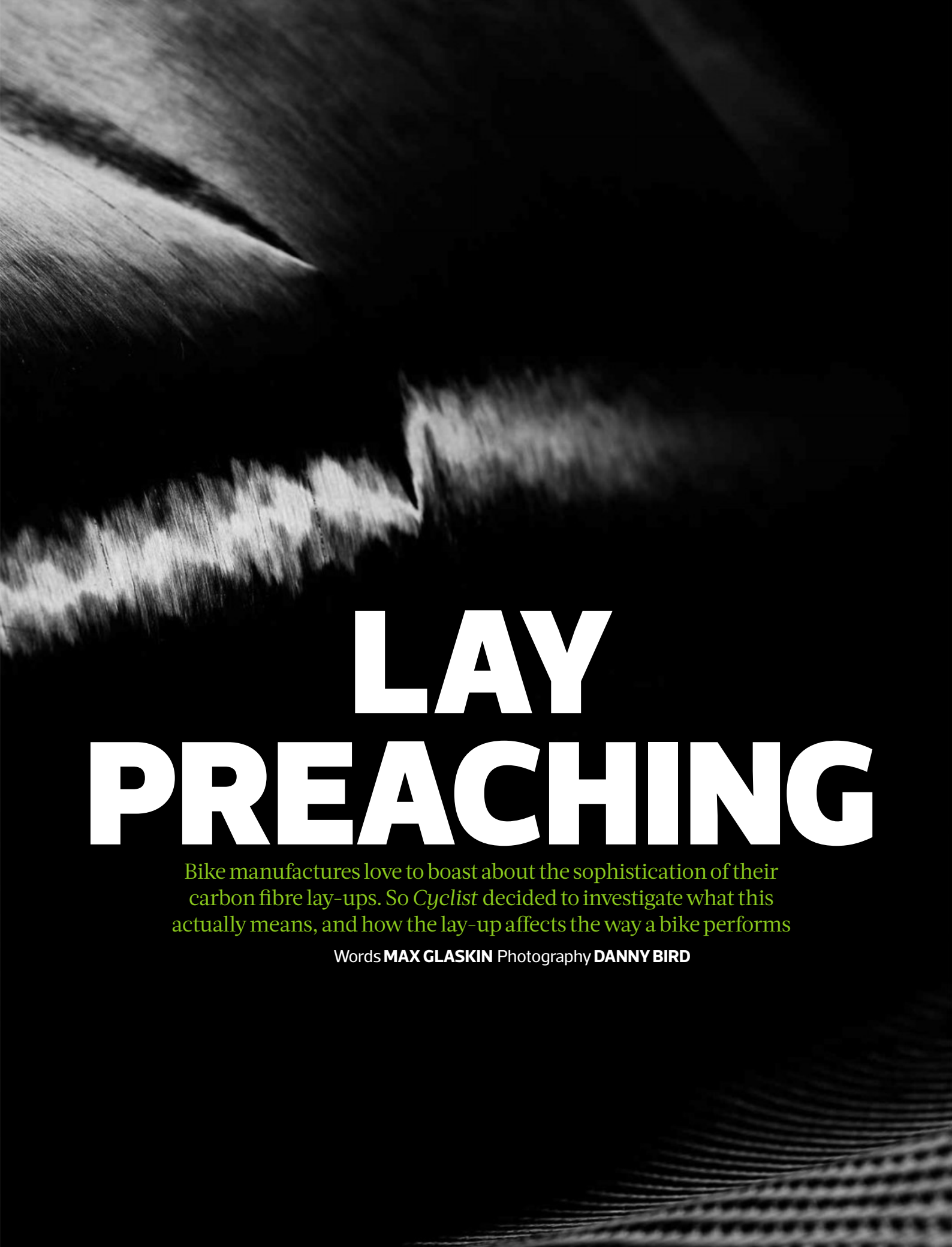
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LAY PREACHING

Bike manufactures love to boast about the sophistication of their carbon fibre lay-ups. So *Cyclist* decided to investigate what this actually means, and how the lay-up affects the way a bike performs

Words **MAX GLASKIN** Photography **DANNY BIRD**

A bicycle, it goes without saying, is the best Christmas present ever, but with the possible exception of a puppy it's also the most difficult to wrap. So pity the poor frame designer who has to wrap and drape carbon around its complex curves such that, when baked and finished, the frame delivers the desired ride feel. The construction of a carbon fibre frame is a complex 3D puzzle that eclipses the Rubik's Cube.

The beauty of carbon is that, unlike metal, multiple pieces can be layered at varying degrees of intersection and overlap to give very tight control over the performance attributes and strength required at any given point of a bike frame. The downside is that carbon is anisotropic – it's stronger in one direction than another in a similar way to wood – which means strength is dependent on the direction of the fibres. For carbon to carry significant loads the forces must be directed along its fibres, which makes fibre direction absolutely crucial. A bicycle frame's constituent sections experience forces in several directions, meaning the carbon fibres must run in several directions too. It's why different layers have their fibres at different angles, commonly 0° (in line), +45°, -45°, +90° and -90°, and indeed any angle chosen by the designers if it will create the desired attributes.

In the depths

That's how it is for all carbon frames. Beneath the lustrous exteriors are many layers of carbon fibre pieces whose stiffnesses, strengths, shapes, sizes, positions and orientations have been painstakingly planned, usually by a combination of computer software packages and engineers' expertise. This is known as the lay-up schedule, or just the lay-up. When the carbon jigsaw is completed the bike must be light, responsive, cost-effective and able to endure the most extreme forces of cycling.

Professor Dan Adams, director of the composites mechanics laboratory at the University of Utah in Salt Lake City, himself a keen cyclist and who was involved with the development of Trek's first carbon frames, says that constructing anything from carbon is all about the correct lay-up schedule. 'It specifies the orientation of individual plies or layers of carbon/epoxy prepreg, stacked up to make the final part thickness,' he says. 'Some frame parts are easier to lay up than others. The tubes are relatively simple but the junctions between them are some of the most complex ply lay-ups you'll see in production parts in any industry that uses carbon structurally, including aerospace and automotive.'

'The junctions between tubes are some of the most complex ply lay-ups in any carbon industry'

Carbon's anisotropic nature also makes choosing the right carbon crucial. At its simplest, there are two ways that carbon is supplied. Unidirectional (UD) has all the carbon fibres running in one direction, parallel to one another. The alternative to UD is a woven fabric, or 'cloth'. It has fibres that run in two directions, going under and over each other at right angles to give the classic appearance of carbon fibre. In the simplest fabric, known as plain weave, the fibres lace under and over at every crossing ▶

(called '1/1') to produce a grid-like pattern. There are many other possible weave patterns. Twill (2/2) is a little looser so easier to drape and easily recognisable by its diagonal pattern, which looks like chevrons.

The modulus (a measure of elasticity) of the fibre is also fundamental to a given lay-up. Modulus defines how stiff a fibre is. A standard modulus fibre, rated at 265 gigapascals (GPa) is less stiff than an intermediate modulus fibre rated at 320GPa. Less of a higher modulus carbon is required to make components of the same stiffness, which results in a lighter product. Higher modulus fibres might therefore seem like the preferable choice, but there's a catch. An analogy can be made with a rubber band versus a piece of spaghetti. The rubber band is very elastic (has a low modulus) and can be flexed with very little force applied but will not break, plus it will return to its original shape after bending. The spaghetti, on the other hand, is very stiff (high modulus) so will resist deformation to a point, and then simply break. Marketing departments often boast about the inclusion of a certain fibre modulus in the latest frame design, but in most cases a bike frame is a careful balance of several types of modulus within the lay-up to deliver a desirable combination of stiffness, durability and flex.

There's one more variable to consider. A single strand of carbon fibre is extremely thin – far thinner than a human hair, so they are bundled together to form what's called a 'tow'. For bikes, a tow can contain anything between 1,000 and 12,000 strands, although 3,000 (written as 3K) is most common.

Fibre this, fibre that

Those are the basics, but creating a lay-up gets complicated. 'From a pure strength and stiffness point of view the ideal composite would have the highest proportion of fibre to resin possible and the least bend in the fibre,' says Dr Peter Giddings, a research engineer at the National Composites Centre, Bristol, who has worked with bikes and raced them for many years. 'Unidirectional fibres, theoretically at least, are the best choice for this. UD materials have an increased stiffness-to-weight ratio in the fibre-direction. Unfortunately UD composites are more susceptible to damage and, once damaged, are more likely to fail than woven fabrics.'

To build a frame exclusively from UD carbon layers would create a bike that was dangerously brittle, not to mention prohibitively expensive owing to the material and man-hour costs (see below). Hence woven carbon dominates and is the obvious choice for any areas where there are tight curves and complex joint shapes. What's more, people like its appearance. 'Aesthetically, woven materials are considered to look better than unidirectional materials and the public's perception of a composite is a woven fabric,' says Giddings. 'In fact, many manufacturers paint [therefore concealing] areas where the frame construction prevents a smooth, woven appearance.'

A bike frame is a careful balance of several types of modulus to deliver stiffness, durability and flex

Ease of fabrication also has to be factored in to a lay-up schedule to take into account

THREAD OF KNOWLEDGE

THE FACTS ABOUT CARBON FIBRE

- Carbon fibre used in bicycle manufacture is a composite of two materials – the fibres themselves and an epoxy resin matrix that encapsulates them.
- Fibres are bundles of carbon filaments each with a diameter of only 10 microns (a human hair is nearer 100).
- Carbon fibres are strongest in tension or compression.
- Carbon fibre is resistant to corrosion and fatigue.
- Generally the higher the modulus, the stiffer the fibre. Unfortunately, it also becomes more brittle. Marketing material claiming frames are constructed of 'high' and 'ultra-high' modulus carbon fibre is misleading, as this quality of carbon fibre is too brittle to use throughout the frame. Hence this type of fibre is used very sparingly and only in certain areas, not to create entire frames.
- A bundle of fibres is called tow and usually contains between 1,000 (1K) and 50,000 (50K) fibres.
- In unidirectional carbon fibre, the tows are parallel.
- In fabric, the tow is woven bi-directionally, going under and over each other at right angles. In its simplest form, the tow weaves under and over at every crossing (1x1). There are many complex weaves (2x3, 4x4, etc).
- The epoxy resin may contain additives: carbon nanotubes may increase damage tolerance; rubber micro-particles may reduce brittleness; incorporating graphene nanoplatelets may increase overall stiffness.
- Carbon is often supplied as prepreg – pre-impregnated with uncured epoxy resin.
- Prepreg is commonly a continuous rolled sheet about a metre wide. It is flexible when stored at low temperatures and can be cut with scissors just like cloth.
- Hardening the resin requires a curing (heating) process usually at temperatures of 100°–180°C for 30–40 minutes.
- Parts that are made by winding or braiding tow around a mandrel (a shaped core) most often have epoxy resin applied afterwards in a separate process.



There are infinite variations available for carbon fibre lay-ups, giving manufacturers huge scope for development and innovation

labour costs. For complex joints and shapes it will take much longer to create the ideal lay-up with UD fibres. It's another reason why woven fabrics are the preferred choice of most carbon bike manufacturers. 'Woven cloth is easier to work with than UD and requires less skill to fit it to a required shape,' says Giddings. 'UD has a tendency to split or kink around complex shapes. Loosely woven fabrics conform more easily and the structure's overall strength is less affected by minor manufacturing defects.'

Manufacturers are likely to opt for a lay-up with woven carbon at the most complex areas, such as the bottom bracket and head tube junctions, but it's still not as simple as it sounds because there's another factor to consider. 'You want to keep continuity of the fibre orientation not just around junctions, but through and beyond them,' says Paul Remy, a bike engineer at Scott Sports. 'There can be complex curvatures at a junction such as the bottom bracket so you have to think of a way to continue the fibres' orientation, to transfer the loading throughout them.'

It's here that frame engineers such as Remy are thankful for the assistance of computer science. In the past the only way to know how the various lay-up schedule alterations might affect the end result was to build and test multiple prototypes, but now a lay-up schedule can be tested with a very high degree of accuracy by computers before a single strand of fibre has touched down in a frame mould.

'Previously it was really difficult to know what effect changing just one part of the lay-up would have on the performance of the frame,' says Remy.

Bob Parlee, founder of Massachusetts-based Parlee Cycles, remembers those old days before computers did all the number crunching rather fondly: 'If you understand the loads on a truss structure such as a frame, lay-ups are straightforward, so initially I could work them out myself in my head.' Parlee has since conceded computer finite element analysis (FEA) has its place. 'Originally I wouldn't put holes in frame tubes [for cable entry points or bottle cage mounts] because they were potential weak spots, but now FEA tells us what to do to reinforce that hole,' he says.

Increasing computing power together with ever-more sophisticated software is allowing engineers to analyse many virtual models in a short time and push the boundaries of design and materials. According to Specialized design engineer Chris Meertens, 'Iteration is the name of the game. FEA tools create a representative model of the frame and the goal is to get every fibre accounted for. The software allows me to design each ply, based on an optimisation model for the 17 load cases that we have for a model frame.'

What that means is the software instructs Meertens how much carbon should be in each area of the frame, and the optimal orientation for the fibres. The skill, though, is in knowing what is and isn't possible with carbon lay-up. Sometimes the computer spits out ideals that are far from ideal. 'Most of the time I look at it and say, "There's no way we can do that,"' Meertens says. 'So then I get busy in laminate draping software to cut virtual plies and drape them on a virtual mandrel, basing it on manufacturing feasibility and laminate optimisations.'

Even using computer software this can take days to decipher, and there's still a long way to go before the lay-up is finally defined. One aspect where the human element is essential is in making sure the right fibre grade is used in the right place. Meertens says, '0° fibre is very stiff but doesn't have good impact strength so, to keep the composite damage tolerant, we have to avoid putting too much in places like the bottom of a down tube. I'll know by this stage what ply shapes I need, but now I want to know how many of each ply. So I run another optimisation program that tells me how thick I should make them – essentially the number of layers. It will analyse anywhere from 30 to 50 combinations of plies. We'll run through the cycle of virtual draping and optimisation four

‘We can do the bending and load tests but we need to get out and ride the finished bike to see if it performs’

or five times, fine-tuning the plies a bit more each time. But at some point we need to hit “Go” and send it off.’

Definitive guide

The lay-up schedule is like a 3D map, detailing each piece of shaped carbon in each layer. ‘The frame is divided up into nine zones: two seatstays, two chainstays, bottom bracket, seat, top, head and down tubes,’ says Meertens. ‘We specify the datum, which is an axis, for each zone. The orientation of every piece of carbon in a zone is then related to that datum. A down tube may have plies at 45°, 30° and 0° relative to the local datum. In general, the higher strength material is used off-axis, at an angle. The higher modulus material we use axially, at 0°.’

The resulting file can be up to 100Mb in size and is eventually passed to the factory floor. Each worker in the factory receives only the portion relevant to the part of the frame they are responsible for creating. This is still not the final production run. The built frame is a prototype at this stage and it needs to be tested to ensure the digitally designed lay-up results in a frame that performs in practice. Ultrasound, X-ray inspection and physical dissection reveal laminate thicknesses. Elsewhere the resin matrix will be burned away to expose the quality of the lamination and whether material or fibres have migrated. Bending tests should show the same results as the FEA analysis. In the end, though, it’s a human who takes it out on the road.

‘Riding the bike is the only way we can truly quantify it,’ says Bob Parlee. ‘We can do the bending and load tests but we need to get out and ride it to see if it performs how we want.’ When the model passes muster, production is finally given the green light.

Most bike production happens in the Far East, and this places even greater importance on the lay-up schedule. The finely detailed plan, if followed to the letter, should ensure the products coming out of those large factories are identical twins of those tested and passed at the final prototype stage. Of course most brands continually test and re-test production frames to ensure consistency so that bikes reaching the shops meet customer expectations. In most cases manufacturers can also trace a frame’s entire journey, right back to the origins of the very first fibre strands. Which is something to think about next time you’re standing and admiring your pride and joy.

Max Glaskin is a freelance journalist and author of Cycle Science

CARBON GLOSSARY

The dictionary of the black stuff

FE or FEA: Finite element analysis software.

Mandrel: A shaped form to support the draped carbon before curing.

Modulus: Stiffness rating (from Young’s modulus).

Plain weave: Fabric woven with each bundle of fibres alternately going over or under each crossing fibre, giving a predominantly grid-like pattern.

Ply: A single layer of prepreg, cut to a shape for a specific part of the frame.

Pre-forming: Placing the prepreg onto your mandrel or into a mould.

Prepreg: A sheet of carbon fibres impregnated with epoxy resin. Usually supplied as a roll, about one metre wide.

Twill: Fabric woven with pairs of fibre alternately going over or under each pair it crosses, giving a predominantly diagonal pattern.



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Pantani's revenge

Cyclist takes on two of Italy's most savage climbs back-to-back at La Campionissimo – but will it prove one climb too many?

Words **PETER STUART** Photography **PATRIK LUNDIN**

This isn't discomfort, this isn't fatigue – this is pain. My only conciliation is the repeated almost ritualistic inward chant of, 'This will end, this *has to* end.' The devastation being wreaked on my body and my psyche makes me believe that the timeline of my life will now be split into pre and post-Mortirolo.

I reach the statue of Italian cycling legend Marco Pantani that punctuates the climb and signifies that there's around a kilometre and a half remaining. I ask some bystanders in a babbled shriek whether the gradient eases off – they shake their heads pitifully. I turn on the hairpin and, as the road reveals itself ahead of me, never before has a kilometre seemed like such a long way.

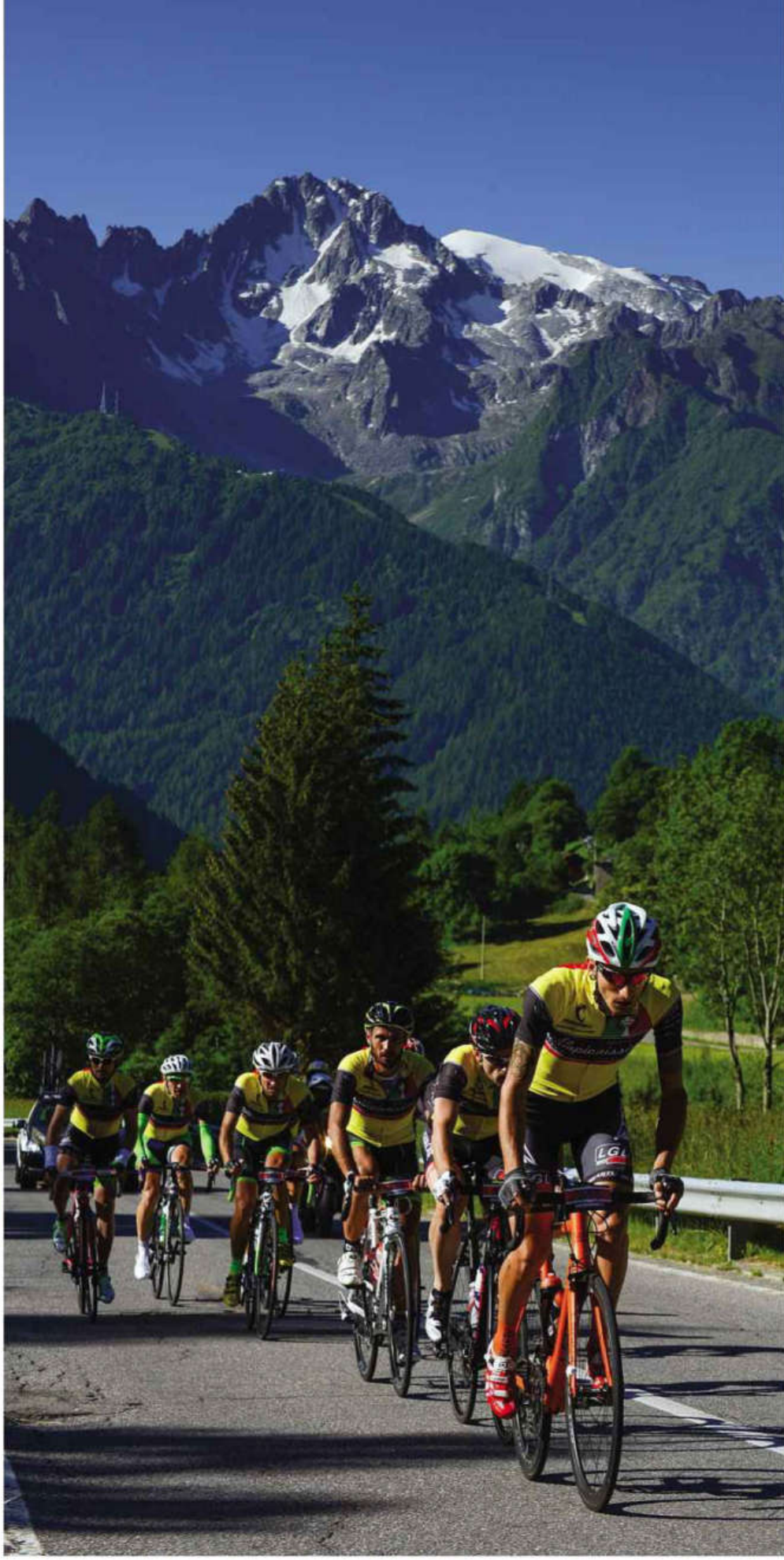
Seeing stars

The Granfondo Campionissimo is a new event, but is also very familiar. Now sponsored by clothing brand Assos, the sportive is officially in its first year but occupies the same slot in the



calendar and the same route as it predecessor, the Granfondo Giordana, which itself took over the same slot and route from the Granfondo Marco Pantani.

The Pantani moniker may have been the most appropriate, as the event is very Italian and very much for climbers. It passes over the Gavia Pass, then the Mortirolo, two of the toughest climbs in Italy, and then tacks on the Passo di Sante Cristina, accumulating more





The details

There are easier ways to get a free T-shirt



What La Campionissimo
Where Aprica, Italy
How far 85km, 155km or 175km
Next one 26th June 2016
Price €60 (€70 on the day) includes free race jersey
More information granfondolacampionissimo.com



A pitch black, steep, 500m tunnel lurks 3km from the finish. Sharp-eyed readers may recognise Katusha's Luca Paolini at the back of this group (albeit temporarily)

Behind me I hear a rider catching up. It's Luca Paolini. Never in my life have I seen a human glide so effortlessly uphill

than 4,500m of vertical ascent in the process, despite a relatively short length of 170km.

Pantani won't be the only cycling legend I see today as, here in the starting pen, not 10 metres from me, stands five-time Tour winner Miguel Indurain. Predictably, he's surrounded by fans snapping selfies and a swarm of journalists. It's 7am and the sun is sitting low in a clear sky in front of us, making for a pretty, albeit blinding, starting straight.

The announcers are in full flow but suddenly everything stops. Luca Paolini has just arrived in full Katusha kit aboard his Canyon Aeroad team bike, but he has no race number and a minor official is giving him a stern, though not entirely serious, reprimand. They let him off, and he squeezes past me and heads for the front of the starting pen. So begins the customary countdown to the off.

The first section is neutralised because it's all downhill – which results in the dragging of brakes for 30 minutes while the Italian racers vie for position and others jostle their way towards Paolini and Indurain. The result is that I'm being squeezed and cut up on every corner, trying to stay out of trouble. At the bottom of the valley the neutralisation lifts just as the road tips skyward and out of sheer frustration at the crowds I sprint ahead. Soon I find myself in the front group, against my better judgement.

The first part of the route to the Gavia, the road from Edolo to Santa Appollina, is a serious climb in itself. It covers 27km at an average of 3% with spikes of over 10% and a few brief drops in elevation. I mix it with the front group for 10km or so, but eventually it dawns on me how suicidal my current tactic is, and ease I off the pace until I drift back into the second group.

Somewhere near Santa Appollina, where the Gavia begins, the sensation of the climb changes from enjoyably challenging to worryingly strenuous. Behind me I hear a rider catching up. It's Luca Paolini. Never in my life have I seen a human glide so effortlessly uphill. He seems to be at an rpm of 60, yet his upper body shows no sign of movement while his quads metronomically propel him ahead. He's noticeable if nothing else by his complete silence, his mouth is closed and he seems to be breathing only faintly through his nose as he floats skywards. I'm going flat out and yet I have no chance of keeping up with him,



The rider's ride

Campagnolo Sarto Asola, £3,600 (frameset only), sartoantonio.com

Sarto is a small framebuilder in Venice but has become well known as a high-end contract builder, often creating top-tier carbon frames for other brands. This Sarto is part of Campagnolo's test fleet, showcasing the brand's new mechanical groupset and carbon clincher wheelset.

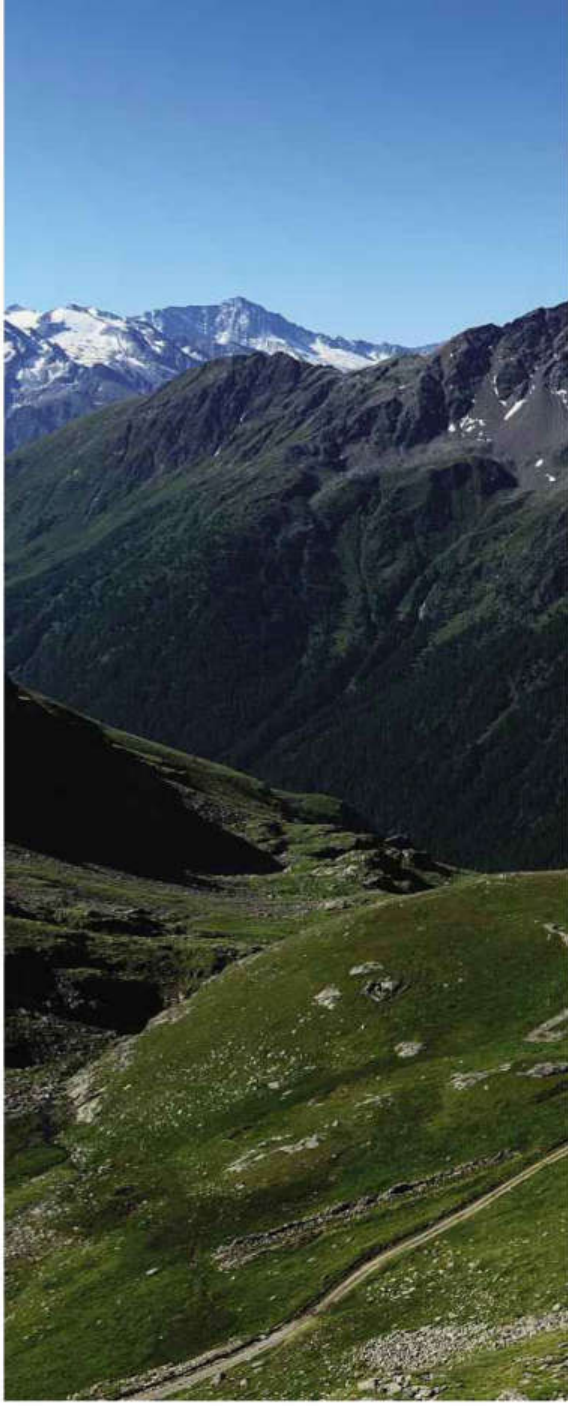
It's at events like these that you realise why Italians make such good bikes. The Asola combines a lightweight feel with stiffness ready to counter any climbing burst or downhill sprint. The bike was a dream to descend on, which was a surprise given its relatively relaxed geometry and tall head tube. The Bora wheelset was also exemplary – light, comfortable, smooth and excellent when braking. Campagnolo Super Record is also excellent for quickly changing inclines and I was extremely glad to be riding a compact chainset.

and before I know it he's out of sight. I look around to see if anyone else shared my wonder at this apparition, but the Italians around me didn't look up from their stems. Everyone else is absorbed in their own personal struggle.

The Gavia keeps on relentlessly, but I'm actually quite enjoying the climb. The gradients hover around 8%, with the last 3km giving way to steeper 12 or 13% ramps. I try to keep up a good pace because I know that the ensuing descent will be closed to traffic for the first few groups only, so it makes sense to arrive at the top with the front-runners.

It proves to be worth the effort – the descent is one of the finest I've ever ridden. With open vistas at the top and smoothly paved roads below, we race down confidently at speeds hovering in the high sixties, punctuated by a couple of brief blasts above the 80kmh mark.

I've ridden plenty of climbs of this gradient and this length, but rarely at the same time. There seems to be no end





I'm glad to have a group of local Italians around me because they know the roads well, although I'm also slightly nervous as they compete for position at over 70kmh. Coming out of Cepina we head into the stunning Valtellina valley. With mountains on each side and the road winding beside a fierce river, the pain of the climb has dissolved into pure riding pleasure.

Then we begin to see signs for the Mortirolo. Some riders fade back in the group, wary of the horrors that lie ahead. I cross the timing mat that will record our efforts on the climb, and pass a sign that tells me that the next 12km will be at an average of 11%. That doesn't sound so bad.

Facing the Mortirolo

Lance Armstrong described the Mortirolo as the hardest climb he'd ever ridden. It's sparing to begin with, with the first 2km averaging around



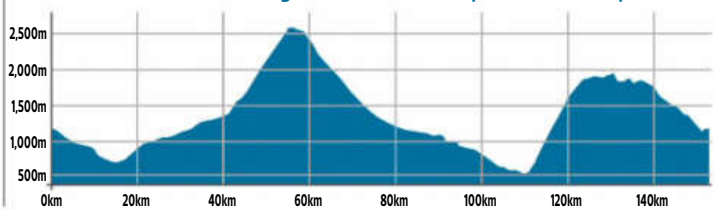
10%, peppered with a few 15% ramps that I dispatch with a couple of out-of-the-saddle efforts, convincing myself that it's all under control. Then it really begins.

The 8km-to-go sign tells me the next kilometre will average 14%. It already sounds steep, and to make things worse the gradient is not distributed in a merciful way. A 20% sign warns of the ramp ahead and I'm soon forced out of the saddle, twisting my entire body from side to side to climb it, with my Garmin barely registering forward motion. It seems impossibly steep and I have to carefully position myself over the bike to balance the twin risks of my rear wheel skidding and my front wheel popping off the ground. I've ridden plenty of climbs of this gradient, and plenty of this length, but rarely at the same time. There seems to be no end. One steep section leads straight into another and

Pretty steep

There's more than one way up the Mortirolo Pass, but only one way to do any of them – slowly

La Campionissimo follows the most traditional route up the Mortirolo, climbing from the Mazzo di Valtellina to the summit for a gruelling 12.4km at a 10.5% average gradient. As with any pass, you can climb from the opposite side, from Edolo, which offers a slightly more forgiving 17.2km at 6.7%. There are two other options: from Grosio at 8.3% over 14.8km, and from Tovo di Sant'Agata. This route was repaved for the 2012 Giro, and some say it's every bit as hard as the standard route. Averaging 10.5%, but over only 11.4km, it skirts the mountainside through thick forest with repeated 20% ramps.



I don't get the chance to settle back into the saddle to ease my aching legs and back.

This treatment continues for kilometre after kilometre. One 20% sign follows another, although my Garmin later tells me the steepest incline was actually an eye-watering 33%. With my lungs burning and my spine aching from the contortions I've been forced into, I know that if I stop I have no hope of starting again. I pass broken men at the roadside with heads in hands. '*This has to end*,' I keep telling myself.

I'm overtaken by a few riders in the middle of the ascent and looking over at them as they pass I see no look of triumph or competitiveness, but rather almost a hint of sorrow in their eyes, a moment of shared sympathy. I am travelling extremely slowly.

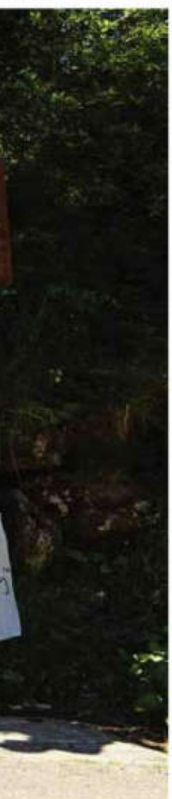
I reach the Pantani monument and make my shrill inquiry about the distance remaining. Despite the poor encouragement I find here the incline does ease off, but even on these shallower slopes I'm still struggling.

Frothing at the mouth like a rabid dog I crawl to the summit. Some bystanders laugh, others look concerned, and everyone is taking pictures. It has taken me an hour and 13 minutes to reach the top. Arriving at the summit is like being



A few riders take a tactical selfie break at the Pantani memorial statue on the Mortirolo Pass





Left: Just one example of the Mortirolo's savagely steep ramps



released from prison (I imagine) and I savour the freedom from torment, but I still have a long way to go and the day is getting very hot.

Looking back I see a group bearing down on me, so I jump eagerly onto the back of the pack. I'm hoping for a speedy and refreshing descent but the Mortirolo offers anything but. The road is dotted with severe cracks and surface irregularities, and with the trees casting sharp shadows it's difficult to separate rough ground from smooth. After rattling over one such crack and almost losing control of the bike I turn with alarm to a rider beside me. He gives me a characteristically Italian shrug and says, 'It's a 50/50 chance down here.' To add to the challenge, the fast down sections are interspersed with short ascents, and each time we arrive at another hill there's a collective groan from the group.

I feel a hint of eagerness to climb back onto my bike and finish the Lungo course. But then my legs fail me and I slump back onto the concrete

Eventually the undulations give way to a genuine descent, and I'm a little concerned about not knowing the perfect line. A svelte rider with an aura of wisdom passes me and I jump on his wheel, only for him to immediately pull on the brakes and unclip in an effort to not hit the armco at the side of the road, which is all that stands between us and a 200m drop on the other side. We make it through, but minutes later I hear a loud pop behind as a rider in a group catching us has his tyre explode beneath him due to the heat. It's enough to make me slow down and take the descent with added caution.

My neck and arms are aching from the strain of absorbing the bumps, and the heat has made the air feel like hot syrup. We're nearing Aprica where the Medio route comes to an end, but I have signed up for the Lungo route, which adds on another 20km of riding, including a 6km climb with 20% stints.

Rolling into Aprica I see the finish line for the Medio route, and the sign pointing the way towards the Lungo route. My resolution is clear. I don't even have to discuss the options with myself. Despite the group of officials waving me towards the Lungo route, I roll over the line with a gratifying 'blip' and lay myself down right there on the pavement. I'm done.

As the pain gradually subsides, I begin to feel a combination of contentment that I conquered the Mortirolo, and a hint of eagerness to climb back onto my bike and finish the Lungo course. Attempting to stand up, however, my legs fail me, and I slump back onto the concrete. Behind me, the winner of the Lungo course is already on stage receiving a bottle of champagne.

There are many sportives longer than La Campionissimo, and others that pack in more vertical ascent, but of all the rides I've done in my life this is quite possibly the hardest. As tough as it is, though, to have ridden on the same roads as Indurain and Paolini, to have climbed inclines that have reduced pro cyclists to tears and to have ridden into such stunning settings as the Valtellina valley or the upper slopes of the Gavia fills me with a warm glow. It's an event that demands respect, but pays full dividends to those who approach it with reverence.

Peter Stuart is still considering going back to complete the Lungo route

How we did it

TRAVEL

Cyclist flew Ryanair to Bergamo, which is well furnished by a variety of carriers from most major UK airports, with fares starting at £70 return. From Bergamo it's an hour and 40 minutes to Aprica by rental car or taxi.

ACCOMMODATION

We stayed at Hotel La Serenella in Aprica (serenella.eu), which was about 200m from the start line. Food was plentiful and bikes were welcome in hotel rooms. If you want to stay here, book very early, as the hotel is small and there are more than 2,000 participants in the event. If accommodation is not available in Aprica, Edolo is a popular and nearby alternative, roughly a 20-minute drive from the start.

THANKS

Many thanks to Assos for hosting our trip to La Campionissimo. Phil Gale of Assos, particularly, offered some excellent advice on how to take on the epic Mortirolo, as well as useful tips on other rides in the area. Thanks also to Joshua Riddle of Campagnolo for the loan of our test bike.


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To enter: Simply visit www.orbea.com/gb-en/myo and design your own bike with the interactive design tool. When you are happy, use the tool to save your design as a PDF, and email it to **orbea@cyclist.co.uk** along with your contact details. The top ten designs, as judged by *Cyclist*'s editorial team, will be shortlisted and sent to an online public vote. The design that collects the most votes will be the winner.

Entry limited to one per individual. No cash alternative will be provided.



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Bikes

Three different routes to happiness



When you're considering a new purchase, the first big decision to make is which class of bike to choose from. Do you go mainstream, with the trusted reputation of one of the biggest international brands? Should you follow your patriotic instincts and look for a British-bred machine? Or do you let yourself be seduced by the idea of handing a blank canvas to an artisan framebuilder, who will fashion a hand-made pride and joy from exotic materials?

Whichever path the buying adventure leads you down, there is something to suit you in the trio of bikes on test in this issue. Choices, choices...

STUDIO PHOTOGRAPHY **HENRY CARTER** RIDER PHOTOS **MIKE MASSARO, DEBORAH MALIN**


p150

Legend Venticinquesimo


p156

Trek Domane 6.9 Disc


p162

Mason Resolution

Legend Venticinquesimo

Venticinquesimo means 25th in Italian. Legend just means legend



Words **JAMES SPENDER**



THE SPEC

Model
Legend Venticinquesimo

Groupset
Campagnolo Super Record EPS

Deviations
Rotor 3D+ chainset with Q-Rings

Wheels
Ambrosio custom carbon tubular

Finishing kit
Legend carbon bars, Control Tech TiMania stem, Legend titanium seatpost, Selle Italia SLR Tekno Flow saddle

Weight 7.19kg

Price £6,300 frameset, £12,000 as built

Contact lebeauvelo.co.uk

Last month *Cyclist* deputy editor Stu Bowers said if he had the money he'd buy the Rolo bike he reviewed. That was a big 'if' as that bike costs the best part of £13,000. And by best part I mean you'd have £200 left to spend on marriage counselling. So, not to be outdone, I hastily bolted my pedals to the Legend Venticinquesimo as soon as it landed in the office and busily set about it with a tape measure and *Cyclist*'s finest torque wrench. At £6,300 for the frameset alone, there was no way I was treating this thing with anything but the kiddiest of gloves. Calling it a work of art is an understatement.

Beauty pageant

There are almost as many quotes about beauty in literature as there are amusing incidents involving cats on the internet (to that end, Google 'Cat in a shark costume chases a duck while riding a roomba', which in years to come will likely be recognised as the zenith of human creativity). One of the best is from Aldous Huxley in his poem *Leda*: 'Beauty for some provides escape/Who gain happiness in eyeing/The gorgeous buttocks of the ape/Or Autumn sunsets exquisitely dying.'

While that might sound a touch flowery, it is an excellent way to sum up my feelings about the Venticinquesimo. I'd draw the line at trying to find parallels between a primate's posterior and the carbon-tubed, titanium-lugged frame, but it's a bike in which beauty provides escape. I mean, just look at it…

Now hopefully you get what I mean. Next to the original Cinelli Laser (which will never be bettered) this is the most beautiful bike I have ever seen.

The lugs might look seamless but are actually made from a series of mitred, welded and hand-filed grade 9 and 5 titanium tubes, each fabricated by Legend's founder, Marco Bertoletti. Into each lug effortlessly sleeves the bespoke carbon fibre tubes, which have been meticulously wrapped and cut so the seams that run



THE BUILD

Despite the lugs looking like they've been sculpted from a single piece of titanium, they're actually made up of separately mitred, welded then painstakingly filed and buffed tubes. Each fabricated by Mr Legend himself, Marco Bertoletti.

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It has impeccable handling. Not just sharp, accurate or confident, but impeccable. It's the same story elsewhere

the length of the weave line up precisely with the tip of each lug. Hand-engraved lettering and logos pepper the head tube and seat tube, and even appear under the bottom bracket shell. The level of detail is amazing, the craftsmanship astounding. There's a case to say it's worth the admission price alone. Yet the Venticinquesimo does whole lot more than just sit there looking pretty.

SUBTLE DETAILS
The more you study the Venticinquesimo, the more there is to see. The inside of the rear dropouts have been inlaid with carbon fibre, while the EPS cable exit point (pictured) is a thing of extraordinary – yet simple – beauty, a second hole drilled in the dropout to funnel the cable through to the derailleur.

Race relations

Before we continue, let's get one thing straight: this is not a race bike any more than an E-Type Jag or an Aston Martin DB5 belongs on a circuit. Yes, those cars could be raced, but they are far too precious, and it's the same with the Venticinquesimo, which marks the 25th anniversary of Mr Bertoletti's company.

'We have made the bike with this mix of materials to represent our story,' says Legend's Manuel Colombo. 'We work in all materials, but Bertoletti is known for his ability to work with titanium. However today we invest a lot of energy in carbon fibre, too. So here we have made a frame close to titanium but lighter, yet still showcasing our welding. This is not a bike for competition, but for people who want something exclusive.'

With the pricetag of £12,000 for this build, Legend can guarantee the exclusivity bit. It's a limited edition as it is, and the fact that the factory has turned out just 15 frames in 11 months tells you just what kind of elite club a Venticinquesimo owner belongs to. However, that's not to say that if you weren't either entirely cold-hearted or obscenely wealthy – or, indeed, both – you couldn't race the Venticinquesimo.

For starters it has impeccable handling. Not just sharp, accurate or confident, but impeccable, sharpening up the faster you ride. It's the same story elsewhere. Although the frame weighs around 1,350g (each one is different as each is made to measure), the overall build here is 7.19kg for a size 56cm. As a result the Venticinquesimo floated finely enough up gradients, with a feeling that much of the weight was held in the bottom half of the frame such that the bike could be flicked from side to side with minimum effort.

There *was* one area in which I found the Legend wanting: stiffness. A swap from the shallow custom wheels by Ambrosio to a pair of deep-section Reynolds 46 Aeros leant more punch, but still the bottom half of the bike felt lacking in urgency at times. While only apparent when pushing it – further down the rev-range and it was solid enough – it was sufficiently flexy to make itself noticed. However, the Venticinquesimo could have been a noodle and I'd still have loved it.

The way you make me feel

There are many bikes that outstrip the Venticinquesimo in performance terms, and I don't think Legend would disagree, but there are very few that present such a rounded, cultivated riding experience. The Festka One we tested in issue 33 was such a bike, as was the Colnago C60 from issue 27. Both very different – one a custom carbon machine, the other a top-level race rig – but in their own way they both presented themselves in the same way. They were refined. They had character. They made me want to ride them. And that, I think, is the most





important characteristic of a bike. Does it make you want to ride it? If the answer is yes, that bike is for you.

The reasons for this are myriad, and often shallow. As great at climbing or sprinting or wind-cheating as your bike may be, if you're honest you probably like it because of the tube shapes, the colour or the headbadge. And that's OK, because cycling has always been this way. It's a fickle business, with teams coming and going on a sponsor's whim, the great stories transcending sporting endeavour and becoming romanticised into folklore. We love the theatre of the sport, we love how it makes us feel. We feel drawn to it. That's how you should feel about your bike, and that's how I felt about the Venticinquesimo.

Would I like this bike as much if it cost £1,500 and lots of people had one? Probably not. When I rode it I felt special, and that feeling was inextricably linked to one of exclusivity. Call me superficial, but then so is cycling. As a sport it is just entertainment; as a pastime it is just indulgent. Beyond fitness or the planet-saving commute, you ride for your own pleasure, so maximise it. Buy something you love, love having it and love riding it.

I reckon I've got at least another 30 years of riding left in me, which means the Venticinquesimo would end up costing just £7.69 a week. Bargain.

The detail



According to Legend's owner and founder, Marco Bertoletti, his favourite frame of all 'is whatever the last frame I have made is'. However, we'd wager that in the event of a fire, Mr Bertoletti would save the Venticinquesimo first. After all, each frame takes around six weeks to make, utilising every fabricating method and piece of experience in Legend's quiver (lead time for a customer is around eight weeks, with each frame being entirely bespoke). However, the Venticinquesimo begs for being more than just admired. Bertoletti's engineering knowhow has produced a surefooted, extremely comfortable and endearing ride that makes you feel like you've known the bike for a lifetime. Which is probably how long you'll love it for.


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Trek Domane 6.9 Disc

Has one the most versatile bikes on the market boosted its potential further by adding disc brakes?



Words **STU BOWERS**



THE SPEC

Model
Trek Domane 6.9 Disc

Groupset
Shimano Dura-Ace Di2 9070

Deviations
Shimano R785 Di2 shift levers and hydraulic disc brakes

Wheels
Bontrager Infinity Elite Tubeless Ready

Finishing kit
Bontrager Race X Lite Isozone carbon bars, Bontrager Race X Lite stem, Bontrager Paradigm RXL Carbon rail saddle

Weight 7.3kg

Price £6,000

Contact trekbikes.com

Back in the 1990s Rowntree's had a TV ad that said, 'Bet you can't put a Fruit Pastille in your mouth without chewing.' A similar challenge could be laid down for the Trek Domane: 'Bet you can't ride a Domane without bouncing up and down on the saddle to see how much the seat tube flexes.' It's just something you have to do to test Trek's claims that its bike offers unrivalled levels of vertical compliance thanks to its unique IsoSpeed decoupler.

This acts like a pivot point created by a bearing hidden away at the junction between the seat tube and top tube, allowing the seat tube to flex almost independently of the rest of the bike. The idea is that on harsh terrain such as that encountered on the cobbled Classics, the Domane will offer greater comfort through absorption of bumps, while not sacrificing the high levels of lateral stiffness required to perform as a top-end race bike. And it works – it really does make a difference to the ride feel, softening blows that would otherwise be transmitted directly into your body, but with no obvious detriment to the stiffness of the lower half of the frame responsible for transmitting pedalling forces. The Domane remains sturdy where it needs to be and Trek's BB90 bottom bracket shell feels as solid and responsive on the Domane as it does on its siblings, the Madone and Émonda. What's more, the IsoSpeed design adds very little weight, and even in this latest disc brake guise, the complete bike (56cm, no pedals) weighs 7.3kg, so is certainly no heavyweight.

Shock and awe

Absorbency at the front has been increased thanks to a new lay-up and profile for the fork, in conjunction with Bontrager's 'IsoZone' handlebar that includes integrated high-density EVA foam. The bar is sculpted to allow the inclusion of the vibration-reducing foam pads without increasing the diameter of the bar, which works well for me, as holding on to something that feels like a pair of



THRU-AXLES
A useful feature of the DT Swiss thru-axle design is that once tightened the levers can then be independently placed in any preferred orientation to keep things looking tidy.

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DATA SENSOR
Trek's integrated DuoTrap sensor is neatly fitted into the chainstay and has the capacity to transmit ANT+ speed and cadence data to any compatible head unit or device.

The thru-axles banish the 'zinging' of the disc rotors against the pads that happens on so many other disc bikes



toilet rolls does nothing for the feeling of connection with the bike and the ground beneath.

The lasting impression of the Domane is that it offers an agreeable ride over rough surfaces while remaining spritely and capable of chasing down the odd climbing Strava KOM too. As an aside, it comes supplied with standard 'tubed' Bontrager R3 tyres, but the Affinity Elite wheelset is tubeless-ready so there's the possibility to upgrade to a tubeless set-up, allowing slightly lower tyre pressures for the same rolling resistance and potentially providing a further improvement to the ride feel.

The Domane won't be right for everyone. Riders who prefer an aggressive set-up might find its high front end an issue, but it will suit anyone who likes to ride quickly without getting beaten up every time the road gets rough. All this, however, is old news. Three years after its launch the Domane's credentials are well established, so the real question then is what, if anything, do the disc brakes on this latest iteration add to the equation?

Belt and braces

Trek has embraced thru-axle technology, front and rear, which means ditching old-style quick-releases and instead connecting the wheels via a fully encapsulated dropout together with a wider, hollow, threaded aluminum axle (15x100mm front and 12x142mm rear). The benefit should be twofold – a more accurate and secure fitment that's also significantly stiffer – and I'm pleased to say that the Domane 6.9 Disc is the first disc braked bike I've ridden with zero brake rub, even when





AESTHETICS
Trek's Ride Tuned seatmast fits over the seat tube rather than into it (as per a traditional seatpost) and offers more height adjustment than fully integrated designs. Trek says it's more comfortable, too.

Shimano's disc brakes are undeniably powerful, but with a sub-70kg rider the stopping force is excessive

making exaggerated movements to try to induce it. On this point, the thru-axles are a significant benefit, banishing the constant 'zinging' of the disc rotors against the pads I've experienced on so many other disc bikes when sprinting or climbing hard out of the saddle. However, the trade-off comes with the aesthetics.

Disc brakes and thru-axles are technologies the road market is borrowing directly from mountain bikes. But for me, what looks acceptable on a mountain bike (which by its nature is burlier) is inappropriate on a sleek road machine. This is where the Domane 6.9 falls down. It's a matter of opinion, but I think the dropouts and axle arrangement, especially at the front, look ugly and over-built, certainly not befitting of an otherwise stealthy carbon road bike. The rear is less jarring, hidden somewhat by the rear triangle, but is still far less visually appealing than it needs to be if this technology is to be accepted. Other brands have used thru-axles with a far less harsh visual impact, for example Storck's Aernario Disc, which is a much cleaner looking design.

The 160mm rotor size isn't helping either. It looks and feels like too much brake for the bike. Shimano's R785 disc brakes are undeniably powerful, but with a sub-70kg rider the stopping force on offer here is excessive. In the wet it required an enormous amount of care not to lock a wheel. Some might say powerful, reliable brakes are a great feature for safety, but I would say you can have too much of a good thing. Dialling down the power, perhaps in this case by fitting a smaller 140mm rotor (which would also look considerably neater) would allow a greater opportunity to tap into the modulation and the 'feel' that hydraulic disc brakes can undoubtedly provide. With the set-up as it was on this bike I was wary of pulling on the levers hard enough to feel the modulation, for fear of locking and skidding the wheels, even in the dry.

In terms of safety and performance, I'm generally in favour of the advent of disc brakes on road bikes, so it was a little disappointing that I found I enjoyed this disc version of the Domane less than the calliper brake alternative. I had initially expected the discs to provide even greater versatility, something the Domane already has in spades, but while the frame still impressed me, the braking if anything sapped some of my confidence to push the limits of the bike on descents and through tight turns. And as for the looks, well... that's for you to decide.

The detail



The arguments about disc brakes taking over from rim brakes on road bikes will rage for some time yet, but if they *are* going to be fully accepted, more focus needs to be placed on how they look. That's an issue for the industry as a whole, not just Trek. The visual appeal of a bike is a fundamental part of the joy of ownership and, while that might be frustrating for bike engineers, the fact remains that beauty often sells better than practicality. Disc brakes might trounce rim brakes in performance terms, but they still have a way to go before they look neat enough to be the go-to choice.


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Mason Resolution

British-designed and Italian-made, the Resolution aims to be all the bike you'll ever need



Words **JAMES SPENDER**



THE SPEC

Model
Mason Resolution Ultegra Di2 Hydro

Groupset
Shimano Ultegra Di2 6870

Deviations
Shimano R785 Di2 hydraulic disc brakes

Wheels
Mason x Hunt 4Season Disc Road

Finishing kit
Deda Zero100 alloy bars and stem, Mason Penta carbon seatpost, Fabric Scoop Pro saddle

Weight 9.27kg

Price £4,195

Contact masoncycles.cc

Dom Mason is obviously not a believer in the principle of *n+1*. While the rule states that the correct number of bikes to own is one more than you currently have, Mason prefers the idea that one bike can do it all – that one bike can be right for all situations in all conditions. That's his Resolution.

Optimally primed

The Resolution might equally have been called the Transformer, because with the right accessories it can turn its hand to pretty much any road-based discipline.

Hidden all over the Columbus steel-tubed frame and Mason's own Aperture disc-specific carbon fork is a plethora of neatly tucked-away bosses to secure mudguards and pannier racks. At a glance you wouldn't notice them, but check the inside of the fork legs or at the back of the chainstay bridge and you'll find bolt holes ready to accept the necessary mounts to turn the Resolution into anything from winter hack to full-on touring rig. Clearances are generous, with space for up to 28c tyres (with mudguards), suggesting the Resolution wouldn't mind a spot of gravel riding to boot, yet strip it back to its bare essentials and the geometry is just about racy enough for someone who wants to mix it on a crit circuit.

Dom Mason, Mason's founder and formerly the engineering brains behind Kinesis UK, calls the Resolution a '4 season' bike. That is, it's a year-round bike, and not just in terms of weather. Mason believes it's just as up to the task of a competitive blast around the park as it is for an eight-hour sportive in the Alps. In fact, the Resolution's alloy stablemate, the Definition (with the same geometry and ethos), took British rider Josh Ibbett to victory at the Transcontinental Race this year – a 4,000km epic from Belgium to Istanbul. Ibbett says he chose the aluminium Definition as it was lighter than the steel Resolution but still comfortable enough, which implies that the Resolution is a little heavier, yet comfier.



FINESSE
A huge amount of thought has gone into the Mason Resolution. Mudguard and pannier bosses (top and bottom of seatstay) are as neat as can be, leaving the Resolution's lines resolutely 'racy'. A chain-hanging tab is a blessed old-school touch to stop the chain dragging on the chainstays when the rear wheel is removed. You don't want to scar paint this good.



Cyclist.co.uk

The Road Bike Site





At 9.27kg for this build, the Resolution is certainly no lightweight, but there is a lot of bike here, including the sturdy Hunt wheels that come in at a claimed 1,585g for the pair, plus disc brake rotors. The question is whether it can deliver on its promise of a comfortable ride.

Refined petro-chemical lovers may disagree, but in my experience steel frames – *good* steel frames – just ride better. The top carbon bikes can almost match this, but I've yet to find one that outstrips the best steel machine in terms of that wonderful intangible feel. Ironing out the road, absorbing the harshness, whatever you want to call it, steel frames make everything just feel a bit soft, like an out-of-focus camera in a dream sequence, or like a big bicycle hug. The Resolution, I'm pleased to say, delivered a particularly warm embrace, even if it was a little stilted. You see, this is actually a pretty stiff bicycle.

To keep with the all-seasons theme, Mason has stuck to a traditional threaded BB shell, citing reliability and dependability when stacked up against the often creaky press-fit brigade. From experience I'd agree threaded shells, if properly maintained, will endure for decades. However, in comparison such a shell sacrifices surface area on which to join tubes, which in theory can limit stiffness because larger tube diameters and junctions normally equate to more rigidity. It's therefore testament to Mason's design that the Resolution displayed plenty of stiffness for efficient mile munching, if ever-so slightly lacking that knock-out punch for top-end sprinting.

Long and low

The geometry on the Resolution is on the relaxed side, with the bottom bracket a touch lower than you'd find on an out-and-out race bike and the wheelbase slightly longer. The result is that the Resolution is very stable at speed due to its low centre of gravity and elongated, planted stance.

In most instances this was welcome, and would be especially so if the bike were laden with panniers. It did mean, however, that the Resolution sacrificed nippiness on winding roads. It was great in long, fast corners, but more technical sections required me to wrestle the Resolution to follow tight lines, as opposed to coax it.

The geometry is relaxed, and the Resolution is very stable at speed due to its low centre of gravity and elongated, planted stance



FRAME INSERTS
Dom Mason hasn't just gone to great lengths to design a versatile frame – he's pushed the envelope in terms of detail too. Special 'Multiport' frame inserts flip-flop to accommodate mechanical or electronic or hydraulic routing and elsewhere, under the bottom bracket, Mason has even made a custom 3D-printed cable guide.



This isn't a deal-breaker – in fact it was rather fun at times, giving me the sensation that I was actually having to drive the bike, that it needed me as much as I needed it. Plus, this handling characteristic is not so extreme that a rider won't be able to adjust to it. It did leave me questioning the '4 season' billing, though.

The perennial question

Can you ride this bike year-round in all manner of ways and weathers? Most certainly, yes. But will you want to? From a personal perspective, the answer is no. Despite having the option to fit mudguards or panniers, for me the frame is just too pretty for those add-ons. The finish is exquisite, and if I owned it I would want to show it off in its best light on every ride. At nearly £4,200 it's also an expensive piece of kit to use as a winter bike. If it were mine, the first time it got a stone chip in the paintwork from a gritted road, the Resolution would be back inside and wrapped up in a blanket till spring.

On a summer's day when the roads are clear and the sun is warm, you won't find a better companion than the Resolution. It is the perfect bike for an all-day cruise. Yet there are other days when you want to blast your bike around, not just on the flat, but up hills and down dales. You want that dynamic feeling, where every muscle in your body is focused on the task of producing all-out speed. You want your bike to feel like a rocket, and the Resolution, no matter how hard I pushed it, never did.

The truth is that, while Mason has produced a very versatile bike, it's not the only bike you'll ever need. Something more expendable would be required for rotten conditions, and something lighter and stiffer would be needed for the days when all that matters is speed. But for those days when you want serene riding pleasure aboard a beautiful machine, the Resolution fits the brief perfectly.



WHEELS
Mason has teamed up with new UK outfit Hunt to help create the Resolution's wheels. Like the rest of the bike, hardy, all-year versatility is the objective.

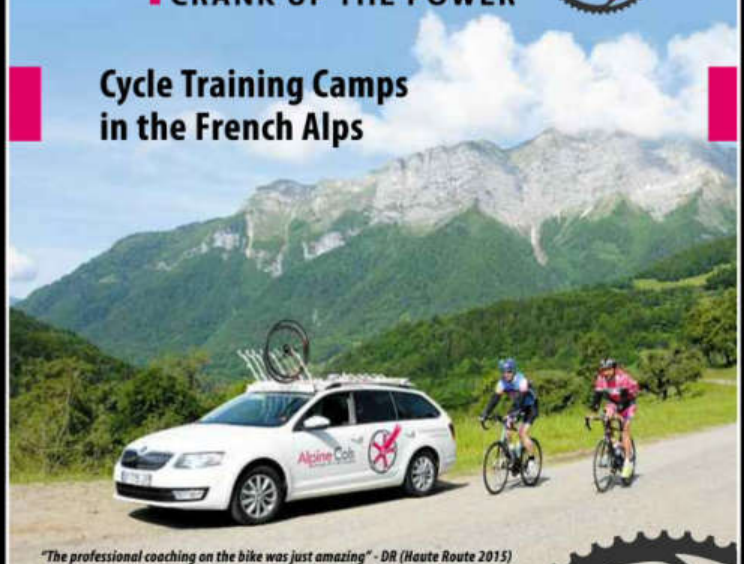
The detail



Shimano's range-topping stoppers, the R785 hydraulic disc brakes, are nothing short of awesome, although a word to the wise: their organic disc pads are highly susceptible to contamination from oil (in most instances that's curtains for the pads), so be extremely careful when cleaning/oiling drivetrains or bleeding the system. Disc performance can be hampered by mounting hardware however, particularly up front, so it's testament to the Mason Aperture carbon fork that no shudder was apparent under braking, that hoses run neatly and internally and that even the graphics (check the gold 'M' on the fork) augment the disc system's looks. A lesson in well-considered design.

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Sram Force 1 groupset

With just one chainring on its new groupset, Sram aims to prove that simplicity is often the best solution

Words ***STU BOWERS***

Price
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Contact
sram.com

I can remember, as a kid, getting my first 10-speed 'racer'. It had a five-speed freewheel with a double chainset, which was important because in those days your bike's kudos was judged by how many gears it had. Since then, gradually more and more sprockets have been crammed in, with all the big three groupset brands now topping out at 11-speed cassettes, facilitating (with a triple chainset) the potential for a mindboggling 33 gears.

More, however, is not always better. All those options can make for a finicky set-up, with awkward chain lines and issues with the chain rubbing the front mech. Besides, some of those gears will be wasted because of duplications (for example, 50/25 is the same as 34/17). Instead, consider the possibility of ditching multiple front chainrings and removing the fuss of front shifting entirely, yet maintaining a spread of gears comparable to that currently available using a compact set-up. Enter Sram's Force 1 – the groupset that has convinced me I may never again need any more than 11 gears.

Proven pudding

1x11 ('one-by' for short) gearing is not a new concept – it has proved itself over a number of years in mountain bike and cyclocross. The road market is going to be a harder nut to crack, but Sram has done the maths and claims



SINGLE CHAINRING
It takes a while to get used to seeing a road bike with only one chainring, but the uncluttered aesthetic is likely to grow on you.

its one-by road groupsets (there are Force and Rival options) can cover 97% of what is currently available using a two-chainring set-up. Whenever I've ridden a one-by bike, it has been met with scepticism by people who can't believe it offers a decent spread of gears or who think that the jump between gears must be too big. My response to them all has been to try it before passing judgement.

I've ridden the one-by set-up for an extensive test period, spanning close to a year. I've used it on a variety of terrains and locations, culminating in the toughest test of all, the Alpen Brevet sportive in Switzerland, known to be one of the most brutal single-day events at nearly 280km with more than 7,000m of vertical ascent.

Throughout this ongoing testing period I've yet to encounter many downsides to this concept, aside from occasionally needing to change the cassette depending on where I was riding. My 11 gears haven't missed a beat and I've seldom been left wanting more. For the majority of the riding I've done around the undulating roads of rural Dorset, I found that a 46t chainring paired with Sram's 11-32 cassette covered most situations. Rarely did I find myself spinning out the 46/11 top gear. Only when speed reached around 60kmh on a downhill, or fast tailwind stretch, was this really an issue. At the other end of the cassette, the 46/32 bottom gear was sufficient to carry me at a comfortable cadence up most gradients, perhaps with the exception of something like a 20% ramp, where I would be forced to ride a lower than preferred cadence out of the saddle. But the occasions when the gearing didn't suit my needs were rare indeed. When I did the Alpen Brevet I switched to Sram's widest ranging 10-42 cassette, giving me a higher top gear as well as a lower bottom gear than a compact chainset paired with an 11-28 cassette.

Sram's one-by drivetrain feels tangibly smoother, more solid and more efficient



GEAR RATIOS

With more cassette ratios on offer than ever before, there's plenty of scope for riders of all abilities to find ratios to suit them – even for tackling Alpine sportives. With 11-28t cassettes becoming the most common standard fitment on road bikes, the 11-32t and 11-36t options don't look too jarring. Admittedly the 10-42t (pictured) is an extreme set-up, but it's only likely to be needed if you're tackling something incredibly steep.

Broad appeal

Using a 10-42 cassette means bigger jumps between gears, which might put off some riders, but my experience was that it's far less noticeable than you might imagine. In fact I found it of little consequence for the majority of situations.

More important is the fact that this one-by drivetrain feels tangibly smoother, more solid and ultimately more efficient in transferring power thanks to Sram's X-Sync chainring. The ring itself is laterally very stiff and its specific, wide-narrow tooth profile is designed to locate and securely hold the chain, whereas multiple chainrings are usually designed for the complete opposite – with teeth shaped to facilitate easy unloading of the chain. Plus the clutched rear derailleur helps to keep the entire drivetrain more taut. As well as feeling really positive, this also keeps things quiet, as the chain will no longer slap and bounce around on a rough road surface. And I didn't drop a chain once during the test period.

Aesthetics are of course subjective, but I'm a fan of the way the single chainring cleans up the look of the front end of the drivetrain, especially when the frame has no braze-on front derailleur mount or, as is sometimes the case (Giant and Canyon to name two), the mount can be removed, leaving no trace of front shifting at all.

There's an argument that it could also be more aerodynamic. Certainly designers could focus more attention on the shaping of the seat tube if they didn't have to worry about the placement of the front mech.

Its simplicity of use is also very appealing – no more having to think about chainlines or consider the best combination of chainring and sprocket. You just shift up or shift down.

It's easy to see why riders might feel cautious about embracing a system that shuns the established norms of road cycling, but don't dismiss the Force 1 until you've tried it. You might just be surprised at what you find.



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Vittoria Qurano 46 Tubular

This is the first time graphene – the new super-material – has been used in road wheels. But does it actually do anything?

Words ***STU BOWERS***

Vittoria has trumped its competitors by being first to introduce graphene into its carbon wheels. It's a substance that could be the most significant advance in bicycle wheel construction since carbon fibre usurped aluminum more than a decade ago.

We discussed graphene's potential in issue 37, but in case you missed that, it's being touted as something of a wonder material. Its discovery by two scientists, Andre Geim and Kostya Novoselov, at Manchester University in 2003 was deemed such a significant contribution to science it earned them both a Nobel prize and knighthoods. Graphene is a single layer of carbon atoms, 0.3 nanometres thick – at least a million times thinner than the paper this is written on – and is 150 times stronger than steel yet 20% more elastic. It conducts electricity better than copper or gold, and sheds heat fast, while being transparent and totally impermeable. Products containing graphene might still be scarce, but everything from mobile phones to aircraft and even condoms (the Bill and Melinda Gates Foundation has donated $100,000 for investment into graphene for the latter) stand to benefit as scientists continue to research and harness its attributes. But what we want to know is: what do we stand to gain from adding it to the carbon composite matrix of a bicycle wheel?

THE DETAILS

Weight
1,312g

Rim depth
46mm rear, 42mm front

Rim width
23mm external

Spoke count
21 rear, 16 front

Price
£1,200

Contact
fisheroutdoor.co.uk







Vittoria makes some pretty bold claims about the improvements graphene makes to the mechanical properties of its Qurano wheels: 10% better heat dissipation, 15% weight reduction, 18% more impact resistance, 20% increased spoke hole strength, 24% more compliance and 50% more lateral stiffness. Yet despite Vittoria's assertion that its findings have been verified by an external laboratory, such statistics will never win me over, and we'd have to destroy the wheels to test them fully. So instead we'll just focus on the results of doing some solid road miles, having paired the wheels with a set of Vittoria's own 25mm Corsa SC tubular tyres.

The boldest of Vittoria's claims relates to the Qurano's lateral stiffness, the foundation of which, it states, is the asymmetric rim shape that balances the spoke angles on left and right sides to get a more even wheel tension. What is graphene's role in this? It's been added to the resin to make the rims stiffer and increase strength around the spoke holes. And during testing the Quranos did indeed feel very stiff during all-out efforts, holding firm as well as any wheelset I've ever ridden. I interspersed my test miles with rides on Zipp's 202 Firecrest and Bontrager's Aeolus 5 Tubeless wheelsets – two of my favourites – yet when I returned to the Vittorias I never felt as if they were holding me back. The performance level was pretty evenly matched.

With their weight close to 1,300g for the pair, the Qurano's combination of low rotating mass and solid build quality results in a really punchy and responsive feel – precisely what you want from race wheels. When I was climbing they felt eager to push onwards, and even on the steepest gradients the wheels didn't flinch. There wasn't the slightest hint of brake rub either, which was impressive given that the Vittoria's are far cheaper than both the Zipps and Bontragers mentioned above.

Number crunching

The rim profile of the Qurano is fairly wide, measuring 23mm externally, but not as wide as those currently pushing the boundaries of rim development such as Enve and Zipp (27mm and 27.8mm wide respectively).

The Quranos felt very stiff during all-out efforts, holding firm as well as any wheelset I've ever ridden

The front rim depth is 42mm, while the rear is 46mm, and although aerodynamic performance is tough to quantify on road tests, the Quranos seemed on a par with the deeper (and wider) Bontrager Aelous 5s. An appreciable characteristic was that the Quranos remained stable in sudden side winds, such as when passing a gap in a hedgerow.

But enough about going fast. One of the potential drawbacks of carbon rims is braking effectiveness, but in this regard the Quranos were well above average. The initial bite of the brake pads (supplied) felt weak, but that's no bad thing as a grabby brake can be unsettling. Instead the braking force came on progressively as I squeezed the levers, and ultimately proved to be effective in both wet and dry conditions. The brake blocks initially seemed to build up a lot of residue on the rim surface, but this lessened over time and the braking performance remained consistent and predictable.

The only glitch I encountered was a rattle from the front wheel that I traced back to a small amount of play in the front hub bearings, for which there was no means to adjust the pre-load and resolve the issue. It was tiny, and it feels like nitpicking, but it was the only imperfection in an otherwise superb pair of wheels. How much influence the graphene really has is hard to quantify, but I'd happily race the Qurano 46 tubulars any day.

RIM PROFILE

It's not until you take a close look at how the valve exits the rim profile that you realise how asymmetric the shape is. This is done deliberately to counter the effect of needing to dish the rear wheel – and it allows the spoke tensions to remain more even from left to right, making for a stiffer wheel.

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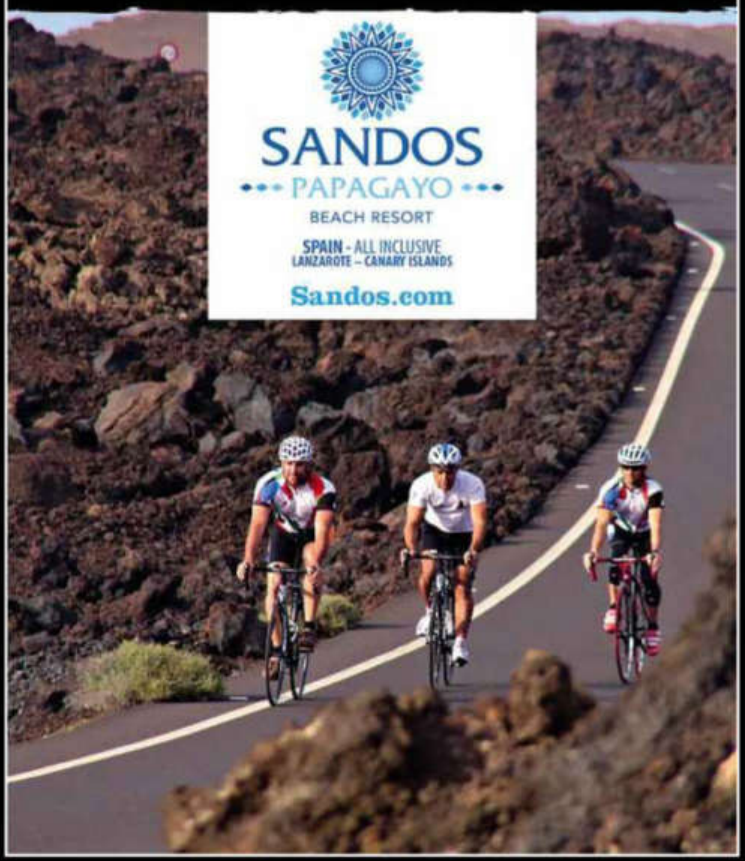
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Stockists

Where to find the stuff you've seen in this issue



Knock Your Socks Off p26

Attaquer Performance, $24.95 (approx £16)
Attaquer Waves $24.95 (approx £16)
attaquercycling.com

Castelli Diverso, £17
saddleback.co.uk

Defeet Levitator Lite, from £11.99
Defeet Levitator Trail, from £11.99
Defeet Aireator, from £9.99
i-ride.co.uk

Happy Socks Stripe, £8
Happy Socks Sprinkles, £8
Happy Socks Triangle, £8
Happy Socks Paisley, £8
Happy Socks Big Dot, £8
happysocks.com

MAAP Block Stripe, $25 (approx £16)
MAAP Dot, $25 (approx £16)
maap.cc

Rapha Cross Pro Team, £20
Rapha Pro Team, £15
rapha.cc

SockGuy Classic 3", £9.95
SockGuy Crew 6", £9.95
SockGuy Crew 8", £10.95
silverfish-uk.com

TICCC Jaques, £13.50
TICCC Fausto, £13.50
TICCC Tom, £13.50
this-is-cambridge.com

Vulpine Dogtooth Merino Silk, £25
Vulpine Merino Polka Long, £20
vulpine.cc



Fuel Economy p41

Velobici Van Abel jersey, £145
velobici.cc

Velobici Van Abel bibshorts, £140
velobici.cc

Bont Vaypor S shoes, £270
saddleback.co.uk



The Austrian Alternative p62

Specialized S-Works Prevail helmet, £159.99
specialized.com

Oakley Racing Jacket sunglasses, £190
uk.oakley.com

Specialized SL Pro jersey, £100
specialized.com

Specialized SL Pro bibshorts, £134.99
specialized.com

Specialized SL Pro socks, £14.99
specialized.com

Specialized Expert Road shoes, £159.99
specialized.com



Efficiency Drive p80

Altura Night Vision socks, £8.99
zyro.co.uk

Vittoria Ikon shoes, £255.99
chickencycles.co.uk



Run For The Hills p96

POC Octal helmet, £225
2pure.co.uk

POC Do Blade sunglasses, £195
2pure.co.uk

Rapha Lightweight jersey, £110
rapha.cc

Rapha Classic bibshorts, £160
rapha.cc

Giro LX gloves, £59.99
zyro.co.uk

Rapha Climber's shoes, £280
rapha.cc



Pantani's Revenge p138

Giro Aeon helmet, £169.99
zyro.co.uk

Oakley Heritage Racing Jacket sunglasses, £190
uk.oakley.com

Assos T.campionissimo_s7 bibshorts, £309.99
assos.com

Rapha Pro Team Data Print socks, £15
rapha.cc

Shimano R321 shoes, £299.99
madison.co.uk



Bikes p149

LEGEND

Lazer Z1 helmet, £199.99
madison.co.uk

Oakley Radarlock XL sunglasses, £195
uk.oakley.com

Sportful R&D Speedskin jersey, *Cyclist* custom, £90
c3products.com

Sportful Bodyfit Pro bibshorts, *Cyclist* custom, £125
c3products.com

SockGuy Welsh Dragon socks, £7.99
silverfish-uk.com

Vittoria Ikon shoes, £255.99
chickencycles.co.uk

TREK

Giro Synthe helmet, £199.99
zyro.co.uk

Oakley Radarlock Path sunglasses, from £145
uk.oakley.com

Alé PRR Bermuda jersey, £90
paligap.cc

Alé PRR 2.0 bibshorts, £105
paligap.cc

Defeet Cyclismo 5" Hi-Vis socks, £15.99
i-ride.co.uk

Sidi Wire Air shoes, £300
saddleback.co.uk

MASON

Lazer Helium MIPS helmet, £169.99
madison.co.uk

Oakley Jawbreaker sunglasses, £169.99
uk.oakley.com

Mavic Ksyrium Pro jersey, £tbc
mavic.co.uk

Mavic Ksyrium Pro bibshorts, £tbc
mavic.co.uk

Mavic Pro Sock, £10
mavic.co.uk

Vittoria Ikon shoes, £255.99
chickencycles.co.uk



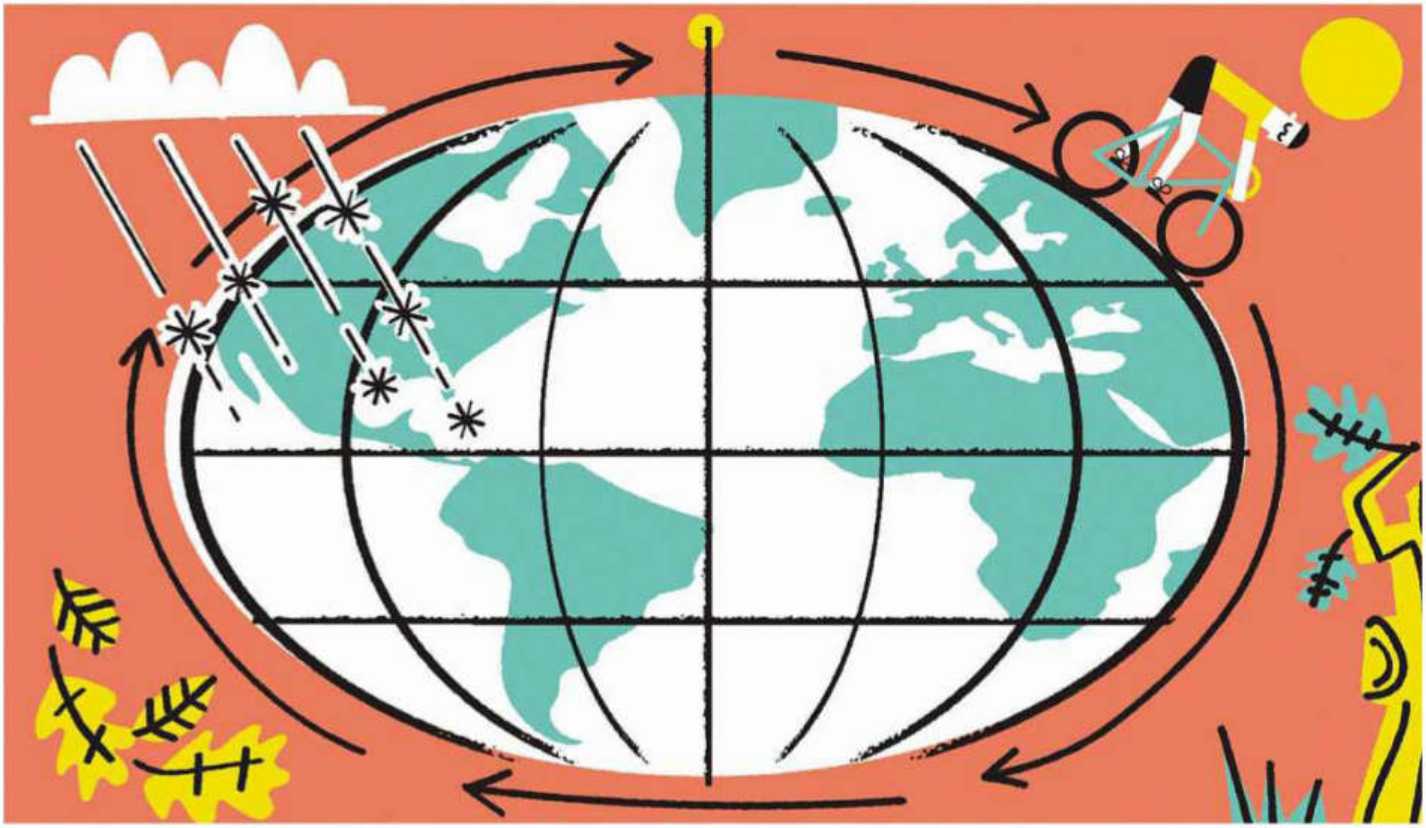
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We want year-round racing

Stuff the winter break, says Eurosport's Felix Lowe, let the show go on...

The leaves of Lombardia have fallen, the winners of the Richmond rainbow stripes decided. We've even had a new Asian rival to Paris-Tours as the end-of-season climax, with the inaugural Abu Dhabi Tour filling the spectator-less void of the defunct Tour of Beijing.

Now's the time the pros head home to reunite with their families, gorge on Nutella and fill in those tan lines by hitting the UV beds in armwarmers and thigh-length compression socks. For us fans, however, we're staring at a three-month cycling desert until the Tour Down Under in late January. But does it have to end here? Surely the show can go on and on, all year round. There are plenty of places around the world that would be perfect for hosting a tour when it gets too chilly for racing in France and Belgium.

How about Eritrea? It was put on the cycling map by Daniel Teklehaimanot's polka dots in July, and it's not too far away from the Gulf region. The temperature is probably just right in late October, so as soon as the Abu Dhabi Tour is over, everyone could hop over the Red Sea for a few days of racing there. It could form the start of a new leg of the UCI Africa Tour, moving down to Ethiopia next, home of Lampre-Merida rider Tsgabu Grmay, before continuing to Kenya for the Chris Froome Classic, and ending up at the already existing Tour of Rwanda in November.

Then it's off to South America, where summer will be just kicking in.

Given the meteoric rise of Colombian cycling, perhaps its national tour could switch from August to the European winter, to cater for those local stars plying their trade abroad. And with a bit of rejigging, we could squeeze the Vuelta a Guatemala and Tour do Brasil into December, finishing the year at the Vuelta a Costa Rica, which traditionally concludes on Christmas Day (for those preferring local pork tamales and eggnog over turkey and mulled wine).

Once the New Year hangovers have subsided, it's northwards to Cuba, which should be back on the calendar thanks to the thawing of relations between the US and Havana. The Vuelta a Cuba ran between 1964 and 2010 and was even won by Pippo Pozzato in 2002, ahead of Mapei teammate Bernie Eisel. The likes of Djamolidine Abdoujaparov, Mario Cipollini and Eros Poli have all raced in the communist country. Joaquim 'Purito' Rodriguez wouldn't need much Cuba convincing either, if only for the marketing possibilities.

Once the Tour Down Under is out of the way, the big gap in February could be filled with a new race in New Zealand. The aerial images alone would encourage a host of new fans obsessed by anything to do with *Lord Of The Rings*, which was filmed there. The leader's jersey would have a single gold stripe – or ring – while the Gandalf the Grey jersey would go to the oldest rider, and the dark lord jersey to the King of the Misty Mountains.

By the time the peloton has made its weary way back to Europe, it'll be ready for Paris-Nice in March, and the whole show can carry on as normal.

It might seem a bit cruel on the riders, but actually it would give them an opportunity to pick their breaks at any time of the year, just like the rest of us. No more would they have to spend the winter months up to their ears in mud on the cyclocross circuit or going round in circles at track events (or if you're grizzled Canadian veteran Svein Tuft, backcountry ski touring while sleeping in a snow-covered tent) to stay in shape. The road racing carnival would simply follow the sun around the world, with the exception of a rain-soaked week in September when everyone comes here for the Tour of Britain.

It's time the WorldTour really lived up to its name and went global.

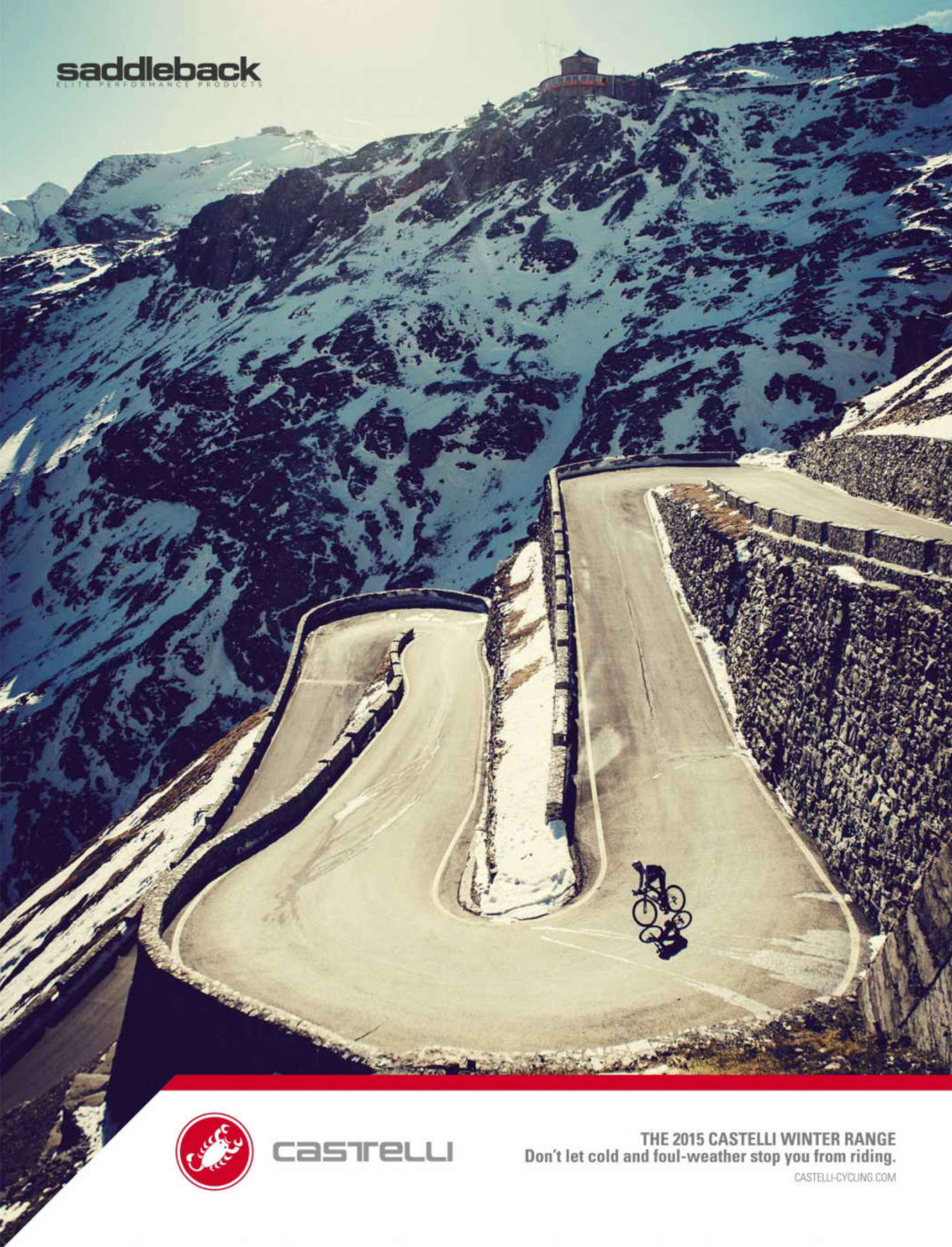
As a blogger for Eurosport, Felix Lowe is now twiddling his thumbs until January's Tour Down Under, and is available for odd jobs, children's parties, bar mitzvahs...

Illustration **Clear as Mud**

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